The Lives Saved Tool

A Computer Program for Making Child Survival Projections

Spectrum System of Policy Models
The Lives Saved Tool
A Computer Program for Making
Child Survival Projections

September 2009
The development of the Lives Saved Tool software and manual was supported by the Bill and Melinda Gates Foundation. It was prepared by Willyanne Decormier Plosky, John Stover, and Bill Winfrey of Futures Institute. The views expressed in this publication do not necessarily reflect the views of the Bill and Melinda Gates Foundation.
# TABLE OF CONTENTS

1. **INTRODUCTION** .......................................................................................................................................... 1

   Description of the Spectrum System ........................................................................................................... 1
   Components .................................................................................................................................................... 1
   Software Description .................................................................................................................................... 2

   Uses of Spectrum Policy Models ................................................................................................................ 2

   Organization of the Model Manuals ............................................................................................................. 3

   What is the Lives Saved Tool? ...................................................................................................................... 3

   Why Make LiST Projections? ....................................................................................................................... 5

   Contact information for the Lives Saved Tool ............................................................................................ 6

2. **STEPS IN MAKING A CHILD SURVIVAL PROJECTION** ........................................................................... 7

3. **PROJECTION INPUTS** ............................................................................................................................... 9

4. **PROJECTION OUTPUTS** .......................................................................................................................... 11

   Child Survival .............................................................................................................................................. 11

   Child/Maternal Survival ............................................................................................................................. 12

   Maternal Survival ....................................................................................................................................... 12

5. **PROGRAM TUTORIAL I: OVERVIEW** ...................................................................................................... 13

   Before You Get Started ............................................................................................................................. 13

   Installing the Spectrum Program .............................................................................................................. 13

   Creating a New Projection .......................................................................................................................... 14
   Starting the Spectrum Program .................................................................................................................. 14
   Opening a Demographic Projection with Planned Use for the Lives Saved Tool (including AIM) ......... 14
   Adding the Lives Saved Tool (and AIM) Module to a Previously Prepared Demographic Projection .... 18

   Saving the Projection .................................................................................................................................... 19

   Opening an Existing Projection ................................................................................................................... 19

   Closing a Projection .................................................................................................................................... 20
6. PROGRAM TUTORIAL II: EXPERT MODE PROJECTION EDITORS ........................................... 21

Configuration ........................................................................................................................................ 21

Entering the Projection Inputs Using Editors ................................................................. 23
    About the Editors in Expert Mode: Editor Screen Format .............................................. 23
    About the Editors: Organization of the Editor Screens ............................................. 25

Coverage ........................................................................................................................................... 25

Health status, mortality and economic status .................................................................. 27
    Baseline Health Status ................................................................................................. 27
    Baseline Mortality ......................................................................................................... 29
    Abortion ............................................................................................................................ 29
    Economic status .................................................................................................................. 30

Effectiveness of interventions .............................................................................................. 31
    Effectiveness of interventions (maternal, <1, and 1-59 months) ...................................... 31
    Herd Effectiveness of Vaccines ...................................................................................... 33
    Effectiveness of nutrition interventions .......................................................................... 33
    Impact of under-nutrition on mortality ........................................................................... 34

7. PROGRAM TUTORIAL III: DISPLAY ................................................................................. 37

Making the Projection ........................................................................................................... 37

Examining the Output ........................................................................................................ 37
    Graphs and Bar Charts ................................................................................................ 39
    Tables ............................................................................................................................... 40
    Pie Charts ........................................................................................................................ 40

8. PROGRAM TUTORIAL IV: TOOLS .................................................................................. 43

Extract ........................................................................................................................................... 43

Scenario Generator .............................................................................................................. 44

9. REFERENCES ......................................................................................................................... 47

10. GLOSSARY OF TERMS ..................................................................................................... 49

11. ACRONYMS AND ABBREVIATIONS ............................................................................... 51

12. COVERAGE INDICATOR DEFINITIONS .................................................................... 53

13. METHODOLOGY ................................................................................................................ 68
LIST OF FIGURES

Figure 1: Schematic of Risk Factors in the LiST Model ................................................................. 69
Figure 2: Illustration of the calculation of the percent of children who are < -3 SD, -3 to <-2 SD, -2 to -1 SDs and above -1 SDs on HAZ relative to international standard ........................................ 78

LIST OF TABLES

Table 1: Age bands and causes of death modelled in LiST .......................................................... 68
Table 2: Calculation of mortality reduction, example ..................................................................... 73
Table 3: Reduction in the odds of stunting from an improvement in complementary feeding .......... 76
Table 4: Reduction in the odds of stunting from reducing stunting in the previous cohort .......... 76
Table 5: Reduction in the odds of stunting from reducing stunting in the previous cohort .......... 77
Table 6: Reduction in the mortality from improved height for age ............................................... 79
Table 7: Reduction mortality from immunization when the herd effect is included .................. 82
Table 8: Notional table of immunization coverage versus percent of unimmunized children who are protected ................................................................. 82
1. INTRODUCTION

Description of the Spectrum System

Components

USAID|Health Policy Initiative and its predecessor projects have developed computer models that analyze existing information to determine the future consequences of today’s development programs and policies. The Spectrum Policy Modeling System consolidates previous models into an integrated package containing the following components:

- **Demography (DemProj)** – A program to make population projections based on (1) the current population, and (2) fertility, mortality, and migration rates for a country or region.

- **Family Planning (FamPlan)** – A program to project family planning requirements in order to achieve national goals for meeting couple’s fertility intentions.

- **Benefit-Cost** – A program for comparing the costs of implementing family planning programs, along with the benefits generated by those programs.

- **Family Planning (FamPlan)** – A program to project family planning requirements in order to achieve national goals for meeting couple’s fertility intentions.

- **Benefit-Cost** – A program for comparing the costs of implementing family planning programs, along with the benefits generated by those programs.

- **AIDS (AIDS Impact Model – AIM)** – A program to project the consequences of the AIDS epidemic including: the number of people infected with HIV, AIDS deaths, the number of people needing treatment, and the number of orphans.

- **Socioeconomic Impacts of High Fertility and Population Growth (RAPID)** – A program to project the social and economic consequences of high fertility and rapid population growth for sectors such as labor force, education, health, urbanization and agriculture.

- **Adolescent Reproductive Health (NewGen)** – A program to examine the effects of policies and programs on the reproductive health of adolescents, including pregnancies, HIV/AIDS, and sexually transmitted infections.

- **Prevention of Mother-to-Child Transmission of HIV (PMTCT)** – A program to examine the costs and benefits of different programs intended to reduce the transmission of HIV from mothers to their newborn children.

---

1 The terms “model” and “module” are used interchangeably in the Spectrum manuals to refer to the separate computer programs within the system.
• **Lives Saved Tool (LiST - Child Survival)** – A program to project the changes in child and maternal survival in accordance with changes in coverage of different child and maternal health interventions.

**Software Description**

Spectrum is a Windows-based system of integrated policy models. The integration is based on DemProj, which is used to create the population projections that support many of the calculations in the other components such as FamPlan, Benefit-Cost, AIM, and RAPID.

Each component has a similarly functioning interface that is easy to learn and to use. With little guidance, anyone who has a basic familiarity with Windows software will be able to navigate the models to create population projections and to estimate resource and infrastructure requirements. The accompanying manuals contain both instructions for users, and equations for those who want to know exactly how the underlying calculations are computed..

**Uses of Spectrum Policy Models**

Policy models are designed to answer a number of “what if” questions relevant to entities as small as local providers of primary health care services and as large as international development assistance agencies. The “what if” refers to factors that can be changed or influenced by public policy.

Models are commonly computerized when analysts need to see the likely result of two or more forces that might be brought to bear on an outcome, such as a population’s illness level or its degree of urbanization. Whenever at least three variables are involved (such as two forces and one outcome), a computerized model can both reduce the burden of manipulating those variables and present the results in an accessible way.

Some of the policy issues commonly addressed by the Spectrum set of models include:

- The utility of taking actions earlier rather than later. Modeling shows that little in a country stands still while policy decisions are stalled, and that many negative outcomes can accumulate during a period of policy stasis.

- The evaluation of the costs vs. the benefits of a course of action. Modeling can show the economic efficiency of a set of actions (i.e., whether certain outcomes are achieved more effectively than under a different set of actions), or simply whether the cost of a single set of actions is acceptable for the benefits gained.

- The recognition of interrelatedness. Modeling can show how making a change in one area of population dynamics (such as migration rates) may necessitate changes in a number of other areas (such as marriage rates, timing of childbearing, etc.).

- The need to discard monolithic explanations and policy initiatives. Modeling can demonstrate that simplistic explanations may bear little relationship to how the “real world” operates.
• The utility of “door openers.” A set of policies under consideration may not be acceptable to all stakeholders. Modeling can concentrate on favored goals and objectives and demonstrate how they are assisted by the proposed policies.

• That few things in life operate in a linear fashion. A straight line rarely describes social or physical behavior. Modeling shows that all social sectors based on the size of population groups are heavily influenced by the exponential nature of growth over time.

• The effort required to “swim against the current.” A number of factors can make the success of a particular program harder to achieve; for example, the waning of breastfeeding in a population increases the need for contraceptive coverage. Modeling can illustrate the need for extra effort—even if simply to keep running in place.

Organization of the Model Manuals
Each manual begins with a discussion of what the model does and why someone would want to use it. The manual also explains the data decisions and assumptions needed before the model can be run, and possible sources for the data. It defines the data inputs and outputs. The manual contains two tutorials, information on the methodology behind the model, a glossary, and a bibliography.

What is the Lives Saved Tool?
The Lives Saved Tool is a computer program for projecting the impact of child and maternal health interventions. It can be used to project the future number/rate of child and maternal deaths, and can stratify that projection by cause of death and by child or maternal health intervention. These projections then can be used in graphic policy presentations intended to enhance knowledge of child survival among policymakers and to build support for effective prevention and care.

The Futures Institute, in collaboration with the Child Health Epidemiology Reference Group (CHERG), prepared the first version of the Child Survival Model in 2008. It was created in response to demand for a model that would allow countries to better target their resources for meeting MDG 4: reducing by two thirds the mortality rate of children under five by 2015.

The Lives Saved Tool is based on the work of the Bellagio Child Survival Study Group, the Child Health Epidemiology Reference Group (CHERG), and the International Child Development Steering Group. Their work has sought to further specify the global burden of disease and developmental impediments for children under-5 years of age both by region and by cause, and to identify and assess those interventions that will be the most effective in increasing child survival and developmental potential. This work has been published in the 2003 Lancet series on child survival (Black 2003, Jones 2003, Bryce 2003, and Victoria 2003), the 2005 Lancet series on neonatal survival (Lawn 2005, Darmstadt 2005, Knippenberg 2005, and Martines 2005), the 2007 Lancet series on child development (Grantham-McGregor 2007, Walker 2007, and Engle 2007), and the 2008 Lancet series on maternal and child undernutrition (Black 2008, Victoria 2008, Bhutta 2008, Bryce 2008, and Morris 2008).
LiST is a work in progress that is continuously adapting to meet the needs of countries and health organizations. It has recently been revised to allow it to interface with AIM and FamPlan. In addition, further reference to nutrition indicators and interventions, a component on maternal health, and the ability to link to an external costing module are now included.

There are two modes in which LiST can be used: EasyList and Expert Mode. EasyLiST is a special feature of the Lives Saved Tool that allows you to use previously prepared child and maternal health and intervention coverage data to quickly make child and maternal survival projections. These quick projections can be made by simply choosing just the interventions and target coverage for each projection you would like to make. The coverage in the present year of 2009 and the target coverage in 2015 is given by default. The user merely chooses which interventions they would like to include by highlighting the adjacent box in the “On/off” column, and makes any changes they choose to the associated target coverage (pursuant to anticipated national or global targets). The user then clicks on “Recalculate”, and will see on the right side of the screen the projection results by age group and year for the projection that was created in comparison to if intervention coverage had not changed from that existing in the present year (2009). An example of the EasyLiST screen is as follows:
The detailed use of the EasyLiST feature is described in the manual:


Please see that manual for further information and instructions on EasyLiST. What follows in this manual will be the description of Expert Mode and instructions for use. Expert Mode is for those users who want to work with the program in greater detail. Expert Mode allows you to review and edit default:

- Coverage of all interventions (from the base year to the target year);
- Baseline health status, child and maternal mortality/cause of death, abortion, and economic status data; and
- Effectiveness of interventions and herd effect of vaccines.

The Lives Saved Tool requires information about child health and nutritional status, deaths by cause, and coverage of child health interventions, in addition to assumptions concerning the efficacy of those interventions. For the purposes of making a national child survival estimate, three additional Spectrum modules are used: 1) DemProj, for the demographic projection; 2) AIM, for the incorporation of the impact of HIV/AIDS on the demographic projection and the impact of treatment upon child survival; 3) FamPlan for the incorporation of lower fertility into the demographic projection.

The Lives Saved Tool (and the entire Spectrum system of models) is designed to produce information useful for policy formulation and dialogue within a framework of computer programs that are easy to use. The focus is on generating information useful for policy and planning purposes rather than on carrying out detailed research into the underlying processes involved. For this reason, the program is designed to be used by program planners and policy analysts. The Lives Saved Tool uses data that are readily available and requires little technical expertise beyond what can be acquired through literature review and use of this manual.

Why Make LiST Projections?

A key aspect of the policy process is recognizing that a problem exists and placing that problem on the policy agenda. LiST projections can illustrate the extent of the tragedy in child and maternal mortality, and the distance needed to go to reach the child survival MDG. Given the impact of child and maternal mortality on almost all areas of development, the projections made by changing the coverage rates in the model represent the hopes and heartbreak of a nation in many ways.

LiST projections are also needed to plan for future needs, not only in terms of care and treatment for children and mothers, but for many of the basic functions of a government. This could include anything from the number of teachers and schools at all educational levels, to tax estimates and retirement planning.

It is often useful to prepare alternative LiST projections rather than a single projection, for the principal reason that it is most useful to be able to compare projections. In this way, the
consequences of inaction and the comparative benefits of devoted attention and resources will be clearly demonstrated.

Contact information for the Lives Saved Tool

For questions or further information on the Lives Saved Tool, please contact:

Futures Institute
41-A New London Tpke.
Glastonbury, CT 06033
(860) 657-5300
http://www.futuresinstitute.org
There are six key steps in making most child survival projections. The amount of time spent on each step may vary, depending on the application, but most projection activities will include at least these six steps.

1. **Prepare a demographic projection.** The Lives Saved Tool requires a population projection prepared with DemProj. This projection should be prepared first, or at the same time as the child survival projection. For a quick start, the EasyProj feature can be used within DemProj to create a population projection based on the estimates and projections of the United Nations Population Division. The first and last years of the DemProj projection will determine the span of the child survival projection.

   If so desired, AIM may also be prepared to use in conjunction with the Lives Saved Tool. The HIV/AIDS projections will be more accurate if the projection is started at least a year or two before the start of the AIDS epidemic. Thus, if the first year in which HIV was detected in the population was 1981, the first year of the projection should be set in Demproj to 1979 or 1980. The projection can start in the middle of the epidemic, but in that case the program needs to back calculate the number and timing of HIV infections that occurred prior to the first year of the projection. This procedure will generally be less accurate than starting the projection before the first year of the epidemic. For the purposes of the LiST Tool, the end date may be set to 2015, so as to monitor progress in meeting the MDGs, or to a later date for evaluating specific targets set by the country.

   The user may further add the FamPlan module to the projection if so desired.

2. **Collect data.** At a minimum, the LiST Tool requires a determination as to the anticipated changes in coverage for the possible child and maternal health interventions. For many other inputs, default values provided by the program can be used, or country-specific figures can be supplied if available. If you are planning to include the AIM module in your child survival projection, it is very helpful to consult your National AIDS Commission to obtain their already prepared Spectrum AIM files. Since the projection will only be as good as the data on which it is based, it is worth the effort to collect and prepare appropriate and high-quality data before starting the projection.

3. **Make assumptions.** The full range of child survival indicators requires assumptions about a number of variables such as the effectiveness of various child health interventions. These assumptions should be carefully considered and based on reasonable selection guidelines.

4. **Enter data.** Once the base year data are collected and decisions are made about projection assumptions, the Child Survival model can be used to enter the data and make a child survival projection.
5. **Examine projections.** Once the projection is made, it is important to examine it carefully. This examination includes consideration of the various child mortality indicators produced as well as the distribution by cause and type of intervention. Careful examination of these indicators can act as a check to ensure that the base data and assumptions were understood and were entered correctly into the computer program. This careful examination is also required to ensure that the consequences of the assumptions are fully understood.

6. **Make alternative projections.** Many applications require alternative child survival projections. Once the base projection has been made, the program can be used to quickly generate alternative projections as the result of varying one or several of the projection variables.
3. **PROJECTION INPUTS**

The Lives Saved Tool requires data describing the causes of child death and the child health interventions to prevent it. Some of these inputs require user input for national data while others rely on recommended values based on a review of scientific studies and data compiled by the CHERG. The inputs that require user data are:

- Demographic projection
- Recent and prospective coverage with each child and maternal health intervention. Recommended values for 2003 are provided. Alternatively, trend files using a baseline survey near the year 2000 and including all applicable surveys to the present, may be used.

Inputs that use recommended values based on international studies and compiled data include:

- Child baseline health and nutritional status.
- Child baseline mortality and mortality by proximate cause.
- Maternal baseline mortality and mortality by proximate cause.
- Baseline percent of pregnancies ending in spontaneous abortions and the abortion incidence ratio.
- Economic status as determined by the percentage of the population living on less than $1/day.
- The effectiveness of each maternal health intervention in reducing maternal mortality, in reference to: antepartum hemorrhage, postpartum hemorrhage, hypertensive diseases and eclampsia, sepsis infections, abortion, obstructed labor, ectopic, malaria, cardio-vascular disease, other direct and other indirect causes of death.
- The effectiveness of each neonatal health intervention in reducing neonatal mortality, in reference to prematurity, tetanus, congenital anomalies, diarrhea, sepsis pneumonia, asphyxia and other neonatal causes of death.
- The effectiveness of child health interventions in reducing child mortality, in reference to diarrhea, pneumonia, measles, and malaria (by age cohort: 1-5 months, 6-11 months, 12-23 months, and 24-59 months).
- The percent of women, neonates, and children in the population who are exposed to the condition being treated (or affected fraction), again in reference to the major maternal, neonatal, and childhood killers.
- The fraction of the population protected by the herd effectiveness of vaccines, in reference to rotavirus, measles, Hib, DPT and bednets for malaria.
• Effectiveness of relevant nutrition interventions on the nutrition-related outcomes of intrauterine growth restriction, stunting, wasting, diarrhea incidence and breastfeeding promotion.

• The percent of children in the population who are exposed to the condition being treated (or affected fraction), in reference nutrition-related outcomes.

• The impact of under-nutrition upon child mortality, which translates the aforementioned nutrition outcomes into impact upon mortality.

Chapter 6 will provide the descriptions for the input of each variable, in the order in which you will encounter them in the program.
4. **PROJECTION OUTPUTS**

LiST will calculate and display a number of indicators grouped under the heading of the Lives Saved Tool (LiST). Changes in the input of coverage rates for relevant child and maternal health interventions will result in the display or corresponding indicators changing, as the effects of greater or lesser support for the intervention become visually evident. A complete list of indicators available for display and their definitions is given below. Demographic projection

**Child Survival**

- **Child deaths:** The total number of child deaths each year.
- **Additional child deaths prevented relative to impact year:** The total number of child deaths prevented each year since the first year of intervention program, by age cohort.
- **Child deaths by cause:** The total number of child deaths each year, broken down by cause of death.
- **Additional child deaths prevented by cause relative to impact year:** The total number of child deaths prevented each year since the first year of intervention program, by cause of death averted.
- **Additional child deaths prevented by intervention relative to impact year:** The total number of child deaths prevented each year since the first year of intervention, by type of intervention responsible to the prevention.
- **Neonatal mortality rate:** The neonatal mortality rate by year.
- **Infant mortality Rate:** The infant mortality rate by year.
- **Under 5 mortality rate:** The under 5 mortality rate by year.
- **Mortality rates summary:** The maternal, neonatal, postneonatal, infant, child, and under 5 mortality rates, by year.
- **Percent stunted:** The percent of children stunted by child age cohort and year.
- **Average height/length:** The average height/length of children in centimeters by child age cohort and year.
- **Breastfeeding prevalence:** The prevalence of exclusive, predominant, partial and non-breastfeeding by child age cohort and year.
- **Diarrhea incidence:** The number of diarrhea cases per child-year by age cohort.
• **Intrauterine growth restriction:** The percentage of intrauterine growth restriction (as measured by percentage of babies born below the 10% percentile of the gender-specific birth weight for gestational age reference curves) by year.

**Child/Maternal Survival**

• **Abortions:** The number of abortions (total, unsafe, and safe), by year.

**Maternal Survival**

• **Maternal deaths:** The total number of maternal deaths each year.

• **Additional maternal deaths prevented relative to impact year:** The total number of child deaths prevented each year since the first year of intervention program.

• **Maternal deaths by cause:** The total number of maternal deaths each year, broken down by cause of death.

• **Additional maternal deaths prevented by cause relative to impact year:** The total number of maternal deaths prevented each year since the first year of intervention program, by cause of death averted.

• **Additional maternal deaths prevented by intervention relative to impact year:** The total number of maternal deaths prevented each year since the first year of intervention, by type of intervention responsible to the prevention.

• **Maternal mortality ratio:** The maternal mortality ratio by year.
5. PROGRAM TUTORIAL I: OVERVIEW

This tutorial covers the key steps in installing and running Spectrum and the Lives Saved Tool. It assumes you have a computer running Windows 95 or higher and that you are familiar with the basic operation of Windows programs and terminology.

Before You Get Started

You will need to collect data and make certain decisions before running the model. At a minimum, the Lives Saved Tool requires a determination as to the anticipated changes in coverage for the possible child health interventions. For other data needs Spectrum provides default patterns that you can use if you do not have information, but you should review these default patterns to make sure they are appropriate for your application.

Installing the Spectrum Program

The Spectrum program is distributed on CD-ROMs or through the Internet at http://www.FuturesInstitute.org. It must be installed on a hard disk before it can be used. Spectrum will operate on any computer running Windows 98 or later version. It requires about 30MB of hard disk space.

To install the Spectrum program, follow the directions below.

**Installing from a CD-ROM.** Insert the CD-ROM into your CD-ROM drive. The installation program should start automatically. If it does not, Select “Start” from the task bar, then select “Run” from the pop-up menu. In the dialogue box that appears, click on Browse, and find the file SpecInstall.exe. Then press “Ok.”

**Installing from the internet.** Start your internet browser and go to www.FuturesInstitute.org. Click on the box that says “Spectrum Download.” You will be brought to the USAID Health Policy Initiative page. Next, click on the “Quick Link” box where it says Spectrum Download (single executable file). From the dialogue box that appears next, select “Save.” (If that dialogue box did not appear, you must click the word “here” where it says “if your download does not begin please click here”). Select a location for the file. Once the file has been downloaded, click on that file and the follow the instructions.

**Changing the language in Spectrum.** The first time you run Spectrum after installing it, all the displays will be in English. You can change to another language by selecting “Options” and “Environment” from the Spectrum menu. Then select the language you want to use and click the “ok” button. At present, Spanish is the only language in addition to English that is currently available.
Creating a New Projection

Starting the Spectrum Program
To start Spectrum:

1. Click the “Start” button on the task bar.

2. Select “Programs” from the pop-up menu.

3. Select “Spectrum” from the program menu. Alternatively, you can use Windows Explorer to locate the directory “c:\spectrum” and double click on the file named “spectrum.exe.”

4. If you get an error saying that the gdiplus.dll file is missing you may have to download this file from Microsoft. It is included with Microsoft Office and recent versions of Windows, but may not be on computers with Windows 2000 or 98.

Opening a Demographic Projection with Planned Use for the Lives Saved Tool (including AIM)

Both the Lives Saved Tool and AIM in Spectrum require a demographic projection prepared with DemProj. In a typical LiST application, the demographic projection calculates the normal demographic processes (births, deaths, migration, aging). The Lives Saved Tool influences the demographic projection by modifying the number of child deaths based on changing coverage rates of child health interventions, and thus changing the life expectancy, migration and possibly the fertility rate. Similarly, AIM influences the demographic projection by adding a number of AIDS deaths and, possibly, specifying a lower fertility rate because of the effects of HIV infection. For more information on AIM, consult the AIM manual for Spectrum that is a companion to this one, *AIM: A Computer Program for Making HIV/AIDS Projections and Examining the Demographic and Social Impacts of AIDS.*

All the population figures required by the Lives Saved Tool (e.g., size of the under-5 population) are provided by DemProj. Therefore, before using LiST you should prepare a demographic projection using DemProj. For more information on DemProj, consult the DemProj Manual for Spectrum that is a companion to this one, *DemProj: A Computer Program for Making Population Projections.* One easy way to create a demographic projection is to use the EasyProj feature of DemProj. To use this feature, follow these steps:

1. Select “File” and “New projection” or “New Trend Projection” from the Spectrum menu. Selecting “New Projection” will allow you to work with default files available by country, with a base year of 2003 and default coverage flatlined from 2003 until the target year.

Selecting “New Trend Projection” will allow you to work with default trend files that include all coverage data from surveys between (approximately) 2000 and 2009. Because the trend files are large, at present only three countries (Bangladesh, Brazil, and Kenya) are included within the Spectrum program, as including all country files would make the Spectrum program too large for many users to download. Trend files for countries other than the four aforementioned must be downloaded from the internet, via a link in the Spectrum Program.
Therefore, if you have a poor internet connection, or if you would like to only look at a small window of time for your projection (for example 2003-2006), the “New projection” option will likely be your best.

2. If “New projection” was selected, you will see the Projection manager dialogue box. It will look similar to the display shown below (if “New Trend Projection” was chosen, see #9-13 below for instructions):

The following information is displayed:

*Projection title:* This title will be printed at the top of all printed output and will be used to identify the projection if more than one projection is loaded at a time. You can change the title to reflect the projection you are about to prepare.

*Projection file name:* This is the name that will be used to store all data files associated with this projection. You cannot change the file name here. You can change it if you select “File” and “Save projection as” to save the projection to new name.

*First year:* This is the first year of the projection.

*Final year:* This is the final year of the projection.

*Active modules:* The check boxes let you select other modules that will be used with the population projection.

3. In the Projection manager dialogue box, fill in the projection title, the first year of the projection and the last year of the projection. If intending to use AIM, it is a good idea to set the first year of the projection to one or two years before the start of the HIV/AIDS epidemic. For the purposes of the Lives Saved Tool, the end date may be set to 2015, so as
to monitor progress in meeting the MDGs, or to a later date for evaluating specific targets set by the country.

4. Check the box next to “Lives Saved Tool (LiST))” to include the LiST module. The box next to “AIM” will then be automatically checked. You may also click on the FamPlan module if you wish to include that as well.

5. Click the “Projection file name” button and enter a file name for this projection. Then click “Save.”

6. Click the “EasyProj” button and select your country from the country list. EasyProj is a special feature that allows you to use data prepared by the United Nations Population Division and published in World Population Prospects. If you click on the EasyProj button, the program will prompt you to select a country and ask whether you want to use the UN low, medium, or high projection assumptions. Once you click “Ok,” the program will load the base year population, the total fertility rate, and the male and female life expectancy from the United Nations estimates and projections.

* Please note, you must enter in the first and last year of the projection BEFORE clicking on EasyProj, or the program will not allow the Lives Saved Tool to be run properly.

7. Click “OK” to return to the dialogue box and click “OK” once more to complete the set-up process.

8. Select “File” and “Save projection” from the Spectrum menu to save this projection.

You can then go to “Edit” and click on “Lives Saved Tool (LiST)” to begin working in the LiST module. Or, click on AIM or FamPlan to begin working in those modules.

* Please note, in a newly initiated Spectrum projection that includes DemProj, AIM, FamPlan and LiST, it is not possible to display Demographic output from DemProj until inputs are completed for the AIM, FamPlan and LiST modules. This is because if DemProj is used in conjunction with AIM, FamPlan and LiST, it draws on the input from those modules to more accurately project demographic outcome. You may choose not to enter in data for AIM or FamPlan. Please note that in the case of AIM, this will cause a serious underestimate of mortality in countries with high HIV prevalence. Regardless, the AIM module must be open to the default values (where adult HIV prevalence is zero) for DemProj to run.

**********************************************************************************************

9. If you selected “New Trend Projection” from the File drop-down menu, you will see the “Trend Projection Manager” dialogue box as follows:
10. Fill in the projection title. Then, click the “Projection file name” button and enter a file name for this projection. Then click “Save.”

11. If the country you wish to work in is one of the four included in the program, highlight that country and click “Ok”.

12. If your country is not one of the four included in the program, click on “Update Trend Files” to be directed by the internet to the following:
13. Click on the box in the “Download” column adjacent to the country you would like to work on, and then click “Ok”. Click “OK” to indicate the file was successfully downloaded, and then click “Ok” once more to complete the set-up process.

If a box is shown in gray, you will not be able to change its contents. It means that a projection has been loaded, and the data must remain the same. If you want to create an entirely new projection, you should close the other projections, using “File” and “Close,” and then select “File” and “New.” Users may want to have several projections open in order to examine the effects of changing assumptions.

Adding the Lives Saved Tool (and AIM) Module to a Previously Prepared Demographic Projection

The first step in adding the LiST (and AIM) modules to a previously prepared demographic projection that did not originally include them as active modules is to open the demographic projection. To do this,

1. Select “File” from the menu bar.

2. From the pull-down menu that appears, select “Open projection.”

3. Select the projection file from the “Open” dialogue box and press “Ok.” All pre-existing projections that can be loaded will be listed here.
4. Once the demographic projection is open, you need to change the configuration to indicate that the AIDS and LiST modules will be used as well. To do this, select “Edit” from the menu bar and “Projection” from the pull-down menu.

5. You will see the Projection manager dialogue box. Check the box next to “Lives Saved Tool (LiST) to include the LiST module (only default 2003 projections can be added to a previously saved projection, and not trend files at present). The box next to AIM will then be automatically checked. You may also click on the FamPlan module if you wish to include that as well.

6. Click “OK” to complete the set-up process.

7. Select “File” and “Save projection” from the Spectrum menu to save this projection.

8. You can then go to “Edit” and click on “LiST (Child Survival)”, AIM or FamPlan to begin working in the module of your choice.

**Saving the Projection**

For future reference, it is always a good idea to save the projection whenever you make a change to any assumptions. To save the projection without changing the name, choose “File” from the menu bar and “Save projection” from the pull-down menu.

To save the projection with a different name, choose “File” from the menu bar and “Save projection as” from the pull-down menu. You will then have a chance to specify a new file name for the projection. Normally when you save the projection with a new name, you should also change the projection title. This step will avoid confusion if you have two or more projections loaded at the same time.

**Opening an Existing Projection**

If you have already created a child survival projection or are using a projection provided by someone else, you can immediately load that projection.

1. Select “File” from the menu bar.

2. Select “Open projection” from the pull-down menu.

3. Select the file you wish to use and click the “Ok” button to open the projection.

You can open more than one projection at a time. Simply repeat these steps to load a second, third, or more projections. When you have more than one projection loaded, all projections will be displayed in the graphs and tables. The number of projections you can load at any one time is determined by the amount of available memory in your computer.

When you have more than one projection loaded, you will be asked to choose a projection when performing certain tasks, such as editing assumptions. The program will display a list of the projection names and you may choose the appropriate one from the list.
**Closing a Projection**

To close a projection that has already been opened,

1. Choose “File” from the menu bar and
2. “Close projection” from the pull-down menu. If you have more than one projection loaded, you will be asked to select which projection should be closed.

Closing a projection merely removes it from the computer’s memory; it does not erase it from the hard disk. You can open that projection again at any time.
6. **PROGRAM TUTORIAL II: EXPERT MODE PROJECTION EDITORS**

For readers who feel they need additional review or explanations of the terms found in this section, Chapter 3 and the glossary of this manual may be useful.

**Configuration**

1. Choose “Lives Saved Tool (LiST)” from the pull-down menu. This step will display the “LiST Edit Mode Selection” dialogue box, as shown below.

![LiST Edit Mode Selection](image)

**LiST has two edit modes: EasyLiST and Expert. Please choose the preferred mode below.**

- EasyLiST
- Expert

[ ] Do not show this message again.

[Ok] [Cancel]

2. If this box does not appear, but rather the “Lives Saved Tool” dialogue box shown below, you may prefer to go to the drop down menu under “Options” and choose “Environment”. Then click on “Enable List Edit Mode Selection” to enable that dialogue box. Users of LiST who only want to work in EasyLiST often prefer to have the “LiST Edit Mode Selection” dialogue box precede the “Lives Saved Tool” box so that they may go immediately to EasyLiST mode.

3. If you have enabled the “List Edit Mode Selection Box”, click on “Expert” and then “Ok” to proceed to the “Lives Saved Tool” dialogue box as follows, Installing the Spectrum Program.
4. Choose “Configuration” from the “Lives Saved Tool” dialogue box. This step will display a box like the one shown below.

```
Base year of coverage
2003

First year of intervention program*
2009

Disaggregate coverage by age cohorts

Ok Cancel
```

5. Select the base year for the Lives Saved Tool from the drop-down menu. At publication, the default data for the new LiST projections is collected to correspond closely to the year 2003. Therefore, if you choose 2003 as the base year for your projection, you will have appropriate default data provided by the model for coverage and mortality rates that you can use or change. If you choose a base year other than 2003, you will need to adjust all values for coverage and mortality rates manually from your own data sources to correspond to the chosen base year. The default data for the new trend projections is collected from all national surveys available between (approximately) 2000 and 2009. Thus, the base year of coverage is variable by country in the default trend files because the first available survey for one country may be 2000, while for another country it may be 2004.
6. Select the first year of intervention program by selecting a year from the drop-down menu. Although the program will be compiling a projection based on demographic and AIDS data from the start year you specified for the projection, and also based on the coverage rates you specified through the base year for the Lives Saved Tool, selecting a first year of intervention program will allow you to narrow the output of the projection so that the impact of an intervention program scaling up coverage from the current year (or year of your choice) can be readily viewed.

7. Finally, click on the box for “Disaggregate coverage by age cohorts” if you would like to enter disaggregated coverage rates, and/or disaggregated intervention effectivenesses. Please note that the default values for these disaggregated coverages and effectivenesses are the same as the aggregated values. The user must supply their own values for the disaggregations. In most cases this level of detail will not be necessary, and the default values for health status, mortality, “herd effectiveness of vaccines” “effectiveness of nutrition interventions”, and “impact of under-nutrition on mortality” will be shown by age cohort whether or not the “Disaggregate coverage by age cohorts box is clicked.

Once you have selected base year of coverage, a first year of intervention program, and decided upon disaggregating coverage by age cohorts, please click “Ok” to return to the “Child Survival” dialogue box.

**Entering the Projection Inputs Using Editors**

**About the Editors in Expert Mode: Editor Screen Format**

The editors are similarly formatted screens which allow you to enter and/or edit the inputs on which a projection is based. At the bottom of the editor are special function buttons which will more easily allow you to work within the cells of the editor when entering data. “Duplicate” allows you to copy information from one cell, column, or row to another; “Interpolate” to enter a beginning and ending number and have the computer calculate the numbers for the intervening intervals; “Normalize” allows you to have the program adjust all values in the table so the total equals 100, if...
you made a change to one cell in the table that caused the total to be different from 100; and “Source” to write notes indicating the source of the data for future reference.

To use the “Duplicate” button,

1. Highlight (select) the range (column, row, or cells to be affected). The first cell in the range should be the value you want to copy.

2. Extend the range to the last year by using the mouse (hold down the left button and drag the range) or the keyboard (hold down the shift key and use the arrow keys).

3. Click on the “Duplicate” key to copy the value at the beginning of the range to all the other cells in the range.

To use the “Interpolate” button,

1. Enter the beginning and ending values in the appropriate cells.

2. Highlight the entire range from beginning to end.

3. Click on the “Interpolate” key to have the values interpolated and entered into each of the empty cells.

To use the “Normalize” function,

1. Click on a table and right click with your mouse. Then highlight “Normalize”

To use the “Source” button,

1. Click on the “Source” button to open a small word processor window.

2. Enter the source of the data and make any special comments about the assumptions.

3. Click on “Close” to return to the editor.

This feature allows you to keep a record of the data sources and assumptions as you make the projections. This source information will be maintained with the data file and printed whenever you print the projection summary. It is strongly recommended that you use this feature to avoid later confusion.

To use the “Cancel” and “Ok” buttons,

The “Cancel” or “Ok” button are usually used only when data has been input for all editors in a editor grouping. Click the “Ok” button to return to program will record your changes and return to the “LiST” dialogue box. The “Cancel” button allows you to exit the editor without making any changes to the data. This action will exit all of the “Efficacy” editors and restore all inputs to their values before you opened the “Efficacy” editors. Any changes you made during the current editing session will be lost.
About the Editors: Organization of the Editor Screens

The editor screens are organized by input variable, each of which is labeled on a tab at the top of the editor. The editor for that variable is brought to the foreground when its tab is clicked on, and it becomes active when the actual editor screen is clicked on.

The variable tabs and the editor screens they house are found within the groupings listed in the LiST dialogue box after “Configuration”:

- Coverage
- Health status, mortality and economic status
- Effectiveness

Instructions on how to access and utilize the LiST dialogue box, the editor groupings within it, and the editors for each variable follow below.

Coverage

Once in the “Lives Saved Tool” dialogue box, click on the green bar for “Coverage” and you will be directed to the following screen:
These coverage editors are the principal screens for the Lives Saved Tool in which the user may (and should!) manipulate the values shown. There are eight coverage editor screens: periconceptual, pregnancy, child birth, immediate postnatal care, breastfeeding, preventive, vaccines, and curative.

1. Click on the tab for the editor screen that you wish to work in, to bring that screen to the forefront.

2. Review the default values listed for each child health intervention and for each age group. The intervention definitions and sources for the default data are listed in Chapter 12, “Coverage Indicator Definitions”. You will see a tab at the bottom of the screen showing that the coverage is for 0-60 months if you did not choose “Disaggregate by age cohort”, or tabs with the age cohorts if you did.

3. The default values listed begin with the base year of coverage. You may enter in data manually if you have it and feel it is more accurate than what is listed.

4. Enter in the coverage targets for future years past the base year. **By changing the target, you will be able to project the impact upon child survival in your country.** Most often, users set a target for the final year of the projection (2015 in this case) and interpolate between the base year and the target year.

5. Use the duplicate function if you would like several adjoining data boxes in a row or column to have the same value.

6. In the “Pregnancy” editor, click on the box “Allow Spectrum to calculate antenatal care components” if you would like the program to assume calculation of coverage for the components that comprise antenatal care and facility based birth interventions. In this case the user will only enter coverage for the antenatal care and facility based birth interventions, as opposed to the coverage for each specific component that comprises them.

7. In the “Child birth” editor, click on “Allow Spectrum to calculate institutional and home delivery components” if you would like the program to assume calculation of coverage for the components that comprise institutional and home delivery.

8. In the “Breastfeeding” editor, data may be entered by either prevalence or promotion, as shown below:
Breastfeeding promotion is by default set by the program to equal the exclusive breastfeeding rate for 1-5 months. However, if you have information on coverage of breastfeeding promotion in your country, you may enter it in manually.

9. When you have completed entering in the coverage rates and chosen if you would like the program to calculate antenatal care and facility based delivery components, click “Ok” to be redirected back to the “LiST” dialogue box.

Health status, mortality and economic status

This editor grouping gives what could be termed the “baseline status” of a child born in the country you are analyzing. It shows the relative hand a child has been dealt, given national figures for pre-natal growth, nutritional status at birth, breastfeeding proportion, baseline mortality rates and the proximate causes for death, and economic status.

Baseline Health Status

From the “Lives Saved Tool” dialogue box, select the purple “Health status, mortality and economic status” bar and you will see a screen that looks like the one below:
1. Please click the boxes for Vitamin A deficiency and/or Zinc deficiency if the intervention population is deficient for those vitamins. Also, please click the box for falciparum exposure if women are exposed to falciparum.

2. Review the default values for percent of women exposed to falciparum, IUGR, wasting, stunting, and incidence of diarrhea. Each is organized by age cohort.

3. If you have more accurate country specific data, click on that box and enter the data. Please note, if you chose a base year other than 2003 for a new projection based on a 2003 default file (i.e. not a new trend projection), you will need to manually enter data for health status for that base year.

4. Please remember to click the “Source” button to enter a record of the data sources and assumptions as you make the projections. In the health status, mortality, and abortion editors, each indicator for which data may be entered has a separate link to the source button. Click on one of the data cells for an indicator (stunting, for example) to highlight it with a black dotted box. Then click, on the “Source” button to enter the source. Then proceed to the next indicator and complete the same process to enter in a source.

After reviewing and/or entering the information in the “Baseline Health Status” editor, click the tab at the top labeled “Baseline Mortality” to move to that screen.
Baseline Mortality

By selecting the “Baseline child mortality” or “Baseline maternal mortality” you will see a screen that looks like the one below:

The “Baseline mortality” editors are similar to the “Health Status” editor.

1. You may choose to review and leave the default values for baseline mortality and percent of all deaths by cause, or you may click anywhere in the editor screen to make it active and begin entering data.

2. When finished with both the “Baseline child mortality” and “Baseline maternal mortality” editors, click on the “Abortion” tab to proceed to that editor.

Abortion

Click on the “Abortion” tab to view the following screen:
1. Please review the default percent of pregnancies ending with spontaneous abortion and the abortion incidence ratio, and make any changes you feel are necessary.

**Economic status**

This editor will have a screen similar to that shown below:

1. Please review and leave the default values for Poverty/food security (beginning in the base year for the Lives Saved Tool), or you may click anywhere in the editor screen to make it active and begin entering data.

2. Remember to click the “Source” button to enter a record of data sources and assumptions if you have entered data.

3. Click the “Ok” button to return to the “Lives Saved Tool” dialogue box. It is suggested that you save your data by clicking “File” and then “Save”.

4. The “Cancel” button allows you to exit the editor without making any changes to the data. This action will exit the editor and restore all inputs to their values before you opened the editor. Any changes you made during the current editing session will be lost. For future reference, if a editor grouping (for example, health status, mortality, and economic status) has more than one editor tab, pressing “Cancel” will exit ALL editors and restore all values to those that existed before you opened the editor grouping.
Effectiveness of interventions

From the “Lives Saved Tool” dialogue box, click on the gray bar labeled “Effectiveness of Interventions. There will then be six editor groupings to choose from, and which will need to be reviewed:

- Effectiveness of interventions (maternal)
- Effectiveness of interventions (<1 month)
- Effectiveness of interventions (1-59 months)
- Herd effectiveness of vaccines
- Effectiveness of nutrition interventions
- Impact of under-nutrition on mortality

These editor groupings show the default values for the effectiveness (the percent of deaths due to a specific cause that are reduced by the intervention) and affected fraction (the percent of deaths due to a specific cause which are potentially able to be impacted by a specific intervention) for each maternal or child health intervention.

Effectiveness of interventions (maternal, <1, and 1-59 months)

The first three editor groupings have editor screens organized by cause of death, that display the default values by intervention and age grouping if applicable, as shown in the example below:
Click on each tab and review the default values for that cause of death.

You may view:

1. The interventions only in reference to the related condition (on tabs at the top of the screen), which is the default presentation; or

2. All types of interventions on one page by checking the box “Show all items”.

You may make any changes you feel necessary. However, please note that the editor groupings and screens for “Effectiveness” are labeled in gray to show that these values come from rigorous research compiled for the Lancet series on Neonatal Survival, and should NOT usually be changed in regard to a specific country context.

1. If you disagree with the default values for effectiveness or affected fraction and would like to enter values that you have prepared, click anywhere inside the editor [screen] to make it active and enter the data. Because the default values are based on rigorous scientific study and are unlikely to need alteration, the cell for any default value that you change will be highlighted in red to show that the value was changed from the default value.

2. Please remember to click the “Source” button to enter a record of the data sources and assumptions as you make the projections.
3. Click the “Display Default” button if you would like to view the value for a cell that was entered in comparison to the default value.

4. If, at any time decide that you would prefer to revert the default values over the data that you have entered, click the “Restore Defaults” button, and the default values for all indicators in the editor will be restored.

When you have finished reviewing the data for all Effectiveness of interventions (maternal), effectiveness of interventions (<1 month), and effectiveness of interventions (1-59 months) click the "Ok" button to return to the “Lives Saved Tool” dialogue box.

**Herd Effectiveness of Vaccines**

The herd immunity grouping is organized slightly differently from the previous three effectiveness groupings, in that the editor screens are ordered by vaccine, age cohort, and coverage rate of the vaccine as seen below:

Declines in mortality from vaccines are modeled based on vaccine effectiveness specific to the child receiving the immunization and a herd effect. The herd effect is modeled as the percent of unimmunized children who are protected by the reduced transmission of the disease resulting from increased immunization rates. The parameters for herd effect are entered as the percent of the unimmunized population which is protected for five percentage point bands beginning at 50 percent coverage. Currently the defaults for herd effect are zero for all vaccines except measles where the herd effect is assumed to be 1.00 when coverage exceeds 95 percent.

As in the previous editor screens, please review the default values and make any changes you feel necessary. The, please continue to the “Effectiveness of nutrition interventions” screen.

**Effectiveness of nutrition interventions**

The “Effectiveness of nutrition interventions” editor grouping shows the effectiveness of nutrition interventions, not directly upon mortality, but rather upon the variables of IURG/low birth weight, stunting, diarrhea, and breastfeeding rates. An example of an “Effectiveness of nutrition interventions editor screen” is as follows:
Please review the default values for each editor (impacts on IUGR, impacts on stunting, impacts on wasting, impacts on diarrhea incidence, and breastfeeding promotion), and then proceed to the “impact of under-nutrition on mortality” editor grouping.

**Impact of under-nutrition on mortality**

The “Impact of under-nutrition on mortality” editor grouping then translates the impact of IUGR, stunting, wasting, and [lack of] breastfeeding upon mortality in children. An example of an editor in this variable grouping is as follows:

```
<table>
<thead>
<tr>
<th>Impact of under-nutrition on mortality</th>
<th>-1 month</th>
<th>1-5 months</th>
<th>6-11 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>IUGR/Low birth weight</td>
<td>21.901</td>
<td>1.063</td>
<td></td>
</tr>
<tr>
<td>Not IUGR/Low birth weight</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact of previous stunting on stunting</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stunted at previous age cohort</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not stunted at previous age cohort</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact of complementary feeding on stunting</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fed secure with promotion</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fed insecure with promotion</td>
<td>1.431</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illness with promotion and supplementation</td>
<td>1.601</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illness without promotion nor supplementation</td>
<td>2.050</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact of diarrhea on stunting</td>
<td>1.040</td>
<td>1.000</td>
<td>1.040</td>
</tr>
<tr>
<td>Impact of zinc supplementation on stunting</td>
<td>1.000</td>
<td></td>
<td>1.000</td>
</tr>
<tr>
<td>Zinc supplemented</td>
<td>1.000</td>
<td></td>
<td>1.000</td>
</tr>
<tr>
<td>Not zinc supplemented</td>
<td>1.110</td>
<td></td>
<td>1.110</td>
</tr>
</tbody>
</table>
|```

Please review the default values for each editor (impacts on IUGR, impacts on stunting, impacts on wasting, impacts on diarrhea incidence, and breastfeeding promotion), and then proceed to the “impact of under-nutrition on mortality” editor grouping.

**Impact of under-nutrition on mortality**

The “Impact of under-nutrition on mortality” editor grouping then translates the impact of IUGR, stunting, wasting, and [lack of] breastfeeding upon mortality in children. An example of an editor in this variable grouping is as follows:
Users must review the following four screens:

- Impact of stunting on mortality (through impact on mortality from diarrhea, pneumonia, measles and malaria, by degree of stunting).
- Impact of wasting on mortality (through impact on mortality from diarrhea, pneumonia, measles and malaria, by degree of wasting).
- Impact of IUGR/Low birth weight on mortality
- Impact of breastfeeding on mortality (through impact on mortality from diarrhea and pneumonia).

When you have finished reviewing all tabs, click on “Ok” to be returned to the “Effectiveness” dialogue box. Click “Close” to be returned to the “Lives Saved Tool” dialogue box, and click “Close” again to exit edit mode.

Please remember to save your projection by using the “Save” or “Save as” functions from the drop-down menu under “File”.

You are now ready to view the output of the projection/s that you created.
7. **Program Tutorial III: Display**

**Making the Projection**

Whenever you enter data for a new projection or edit the variables, Spectrum will note that the data have been changed. The next time you try to display an indicator, it will inform you that the data may have changed and ask if you want to recalculate the projection. Normally, you should answer “Yes” to this question. Spectrum will then make the projection. This step may take only a few seconds or much longer, depending on the length of the projection and the number of modules being used. Once the projection is made, you will not be asked if you want to project the population again, unless you edit the variables.

**Examining the Output**

To see the results of the projection, select “Display” from the menu bar. From the pull-down menu select “Lives Saved Tool (LiST).” You will then see another menu showing the indicators available:

- Child deaths
- Additional child deaths prevented relative to impact year
- Child deaths by cause
- Additional deaths prevented by cause relative to impact year
- Additional child deaths prevented by intervention relative to impact year
- Maternal deaths
- Additional maternal deaths prevented relative to impact year
- Maternal deaths by cause
- Additional maternal deaths prevented by cause relative to impact year
- Additional maternal deaths prevented by intervention relative to impact year
- Maternal mortality ratio
- Neonatal mortality rate
- Infant mortality rate
- Under 5 mortality rate
- Mortality rates summary
- Percent stunted
- Average height/length
- Breastfeeding prevalence
- Diarrhea incidence
- Intrauterine growth restriction
- Abortions

Select one of the indicators. Then you will see the display dialogue box. It will look similar to the one shown below.

The exact choices available will depend on the indicator you have selected. The display will normally be in single years, but you may change it to display every five or ten years if desired. The chart type is also set through this dialogue box. Click on the button next to the type of display you want. Normally the display will show all the years in the projection. However, if you want to see only part of the projection, you can change the final year by selecting a new final display year from the “Final year” list box. You may also select the age cohort to display for some indicators, by using the drop-down menu for “Select age cohort to display”.

Once you are satisfied with the type of display, click the “Ok” button and the display will appear. It will look similar to the display shown below.
All the projections that are currently in use will be displayed on the same graph.

You can change the configuration of the display by clicking the “Configure” button. You can also change the type of display by placing the mouse pointer anywhere inside the chart and clicking with the right mouse button.

To close the display, click on the “Close” button. You do not have to close the display immediately. You can choose to display another indicator and it will appear on top of the first display. The first display will be covered but it will still be there. You can return to any previous display that you have not closed by choosing “Window” from the menu bar and selecting the name of the display from the pull-down menu. From the “Window” selection you can also choose to tile or cascade all the existing display windows.

**Graphs and Bar Charts**

Spectrum will display a variety of graphs and bar charts, including:

- Line charts
- Two- and three-dimensional bar charts (column charts)
- Two- and three-dimensional horizontal bar charts
- Two- and three-dimensional overlap bar charts (bars for multiple projections are shown on top of one another)
Select the “table plus chart” box, if you would like to see the table values displayed across the bottom of the chart.

- **Please note:** For the indicator “Under-Five Mortality Rate”, a green arrow will appear on the chart at the year 2015, representing the MDG target for child mortality. Therefore, it is easy for viewers to see if the target will be met with the projected changes to coverage for the selected child health interventions.

To print the active chart, select “File” from the menu bar and “Print” from the pull-down menu.

### Tables

Spectrum will also display data in the form of tables. In tables, each projection that is in use will be displayed in a separate column. You can scroll through the table to see all the years by using the PgUp and PgDn keys or by using the mouse.

To print a table, select “File” from the menu bar and “Print” from the pull-down menu.

### Pie Charts

For the indicators that are stratified by cause (of death or death prevented) or type of intervention, a pie chart may be displayed. In this case, the display dialogue box will look like the following:

A. Select the radio button for “Pie Chart.”

B. Choose the display interval by clicking the radio button next to your choice. As with other display formats, the display will normally be in single years but you can change it to display every five or ten years if desired.
C. Choose the year that you would like to see displayed. Once you are in the pie chart display, you may click the “Prev” or “Next” button to display the pie chart for the previous or next year.

D. Choose the grouping percentage. The percentage listed is that below which no values will be displayed. This is used to simplify the pie chart display. For example, if your original pie display with the grouping percentage set at zero shows only a few causes of death accounting for 95% of deaths and numerous causes accounting for 5% of deaths, you could set the grouping percentage at 5%. The numerous causes totaling 5% would thus be shown only as “other”, and the pie chart will be easier to read.

E. Choose the projection that you would like to see displayed.

Then click “Ok.” You will see a display like the following:

![Pie chart showing causes of death](image)

To copy the charts you may press “Print Screen” on your keyboard, and then “Ctrl and V” to paste into Paint, Word, or PowerPoint. To export data from a screen, mouse over the top left corner of any table, right click to copy all, and then press “Ctrl and V” to paste into Excel.
8. PROGRAM TUTORIAL IV: TOOLS

The tools in Spectrum allow for further use of the data generated while creating projections. Those currently available for use with LiST include:

- The extract feature, which enables you to extract the projected data from one projection (or multiple projections) on one or more indicators. The extracted data is then saved to a CSV file, and can be imported into excel for further analysis. An example would be to use the extract feature to extract the data for “Child deaths” and “Maternal deaths” for both Brazil and Mexico into an excel table all at once.

- The scenario generator feature enables you to quickly vary the target coverage for one or more child and/or maternal health interventions, across multiple projections. An example would be to generate one scenario for all African countries where target coverage of insecticide treated nets reaches 50% by the target year, and another scenario where target coverage of insecticide treated nets reaches 80%.

Extract

After entering Spectrum, go to “Tools” and click on “Extract” from the drop-down menu. (Note: You cannot use the Extract function if you have a projection file open. If the “Extract” menu appears in gray, select “File” and “Close Projection” to close the projection. Then you should be able to select “Extract”.) An “Extract” window will open, in which the white “choice” boxes will be empty. Below is an example of what the “Extract” window looks like once filled in, followed by instructions on how to do so:
A. For the “Chosen Projections” box, click “add” to browse and add a previously saved projection. Highlight a projection from the “Chosen Projections” box and click “remove” to remove it.

B. Once a projection is added to the “Chosen Projections” box, the indicators for that projection will appear in the “Indicators” box. Click on the “+” to open a category and see the indicators housed within it.

C. To pull an indicator into the box of “Selected Indicators” that you wish to work with, highlight the indicator in the “Indicators” box and press the “>>” button. To remove an indicator from the “Selected Indicators” box, highlight it and click “<<.” In other modules of Spectrum, you may further refine your selected indicator by sex or region (urban/rural) through highlighting the indicator in the “Selected Indicators” box and clicking “Configure.” However, there are currently no indicators in LiST that have such breakdown data, and thus this function is not applicable for Extract with LiST projections.

To process the extraction, click the “Process” button. Enter the file name you wish to save the extraction as, and click “Ok.” It will then be saved as a CSV file, ready for use in Excel.

If you do not wish to process the extraction immediately, but would like to save the “Extract” window in which you have pulled out the mix of projections and indicators that you would like to use in the future, click the “Save” button. Enter the file name you wish to save the “Extract” window as, and click “Ok.” It will then be saved as an .ex file.

If you have a previous “Extract” window saved as an .ex file, you may open it by clicking the “Open” button.

Scenario Generator

After entering Spectrum, go to “Tools” and click on “Scenario Generator (LiST)” from the drop-down menu. A “Scenario Generator (LiST)” window will open, in which the white “choice” boxes will be empty. Below is an example of what the “Scenario Generator (LiST)” window looks like once filled in, flowed by instructions on how to do so:
A. Choose the “Intervention Year” and “Target Year”. Often, the intervention year is the current year.

B. Choose a “Scenario Name”. Then, in the “Selected Projections” box, click “add” to browse and add a previously saved projection. Highlight a projection from the “Chosen Projections” box and click “remove” to remove it. Then, select where to save the projection by clicking on the file folder icon beneath “Save projections in the following location” and choosing from the drop-down list. It will then be saved as a Scenario Generator file (.SG file).

C. Check the boxes in the “On/off” column next to the indicators you wish to use in your scenario.

D. In the Target year column, click on the box in the row for each intervention you want to include and enter in a target coverage.

E. Click on the “Flatline unchecked interventions” box if you would like the program to flatline coverage for all interventions that were unchecked in the “On/off” column, from the intervention year to the target year. Often, this will be the preferred choice, as it allows you to project the impact of only the intervention/s that you select in the “On/off” column and set a target coverage for (as compared to the status quo). However, in some cases the user may have previously prepared projection files that have target coverage already set for a specified set of indicators, and they may wish to have the program keep those coverage settings with the exception of one (or more) indicators for which a new target coverage will be applied through the scenario generator. In that case, the “Flatline unchecked interventions” box should remain blank. A simple example would be if an organization had
set target coverage in the selected projected files for all interventions to be 80% in 2015, but wanted to explore the effect of increasing antenatal care to 90% by 2015.

To process the scenario generation, click the “Process” button.

If you do not wish to process the scenario generation immediately, but would like to save the “Scenario Generator (LiST)” window in which you have pulled out the projections that you would like to generate scenarios for in the future, click the “Save” button. Enter the file name you wish to save the “Scenario Generator (LiST)” window as, and click “Ok.” It will then be saved as an .ex file.

If you have a previous “Scenario Generator (LiST)” window saved as an .ex file, you may open it by clicking the “Open” button.
9. REFERENCES


10. GLOSSARY OF TERMS

**Affected Fraction.** The percent of the population who are exposed to the condition being treated.

**AIDS.** The abbreviation for the acquired immune deficiency syndrome, a disabling and fatal disease caused by the human immunodeficiency virus (HIV).

**Child.** For the Lives Saved Tool, a person under the age of five years old.

**Efficacy.** The ability to produce a desired [positive] effect.

**Exclusive breastfeeding.** Giving no liquids or solids of any form in addition to breastmilk.

**Epidemiology.** The study of the incidence, distribution, and determinants of an infection, disease, or other health-related event in a population. Epidemiology can be thought of in terms of who, where, when, what, and why. That is, who has the infection/disease, where are they located geographically and in relation to each other, when is the infection/disease occurring, what is the cause, and why did it occur?

**Infant Mortality Rate.** The number deaths of infants one year of age or younger per 1000 live births.

**Interpolation.** Given two numbers that serve as boundary points, it is possible to estimate the values that lie at intervals between the two points. For example, if the HIV prevalence rate for a country or region was actually measured only in 1985 and in 1995, by assuming even increments from year to year, it is possible to interpolate a TFR for each intervening year. Spectrum uses a linear form of interpolation so that the difference between each annual value is the same. Other nonlinear forms of interpolation are also possible but are not used in Spectrum.

**Life Expectancy.** The average number of years a newborn can expect to live, based on the mortality and conditions of the time.

**Maternal death:** The death of a woman while pregnant or within 42 days of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes.

**Maternal mortality ratio:** The number of maternal deaths per 100,000 live births.

**Mild stunting.** Between -1 and -2 standard deviations from median height for age of reference population.

**Model.** Computer system designed to demonstrate the probable effect of two or more variables that might be brought to bear on an outcome. Such models can reduce the effort required to manipulate these factors and present the results in an accessible format.

**Moderate stunting.** Between -2 and -3 standard deviations from median height for age of reference population.
**Module.** Synonym for “model.”

**Neonatal Mortality Rate.** The number of children dying under 28 days of age divided by the number of live births that year.

**Partial breastfeeding.** Giving solids and liquids (including milk that is not breastmilk), in addition to some amount of breastmilk.

**Predominant breastfeeding:** Giving only breastmilk and other non-milk liquids (juices, teas, water). Child receives no solids or milk that is not breastmilk.

**Relative Risk.** The probability of death to children exposed to an intervention relative to (or divided by) the probability of death to children not exposed to the intervention.

**Severe stunting.** More than -3 standard deviations from median height for age of reference population.

**Stunting.** Below -2 standard deviations from median height for age of the reference population.

**Under-Five Mortality Rate.** The probability (expressed as a rate per 1,000 live births) of a child born in a specified year dying before reaching the age of five if subject to current age-specific mortality rates.
11. **ACRONYMS AND ABBREVIATIONS**

- **AIDS**: acquired immune deficiency syndrome
- **AIDSCAP**: AIDS Control and Prevention Project (USAID-funded)
- **AIDSTECH**: AIDS Technical Support Project (USAID-funded)
- **AIM**: AIDS Impact Model
- **CDC**: U.S. Centers for Disease Control and Prevention
- **CMR**: child (under-five) mortality rate
- **FHI**: Family Health International
- **GDP**: gross domestic product
- **GNP**: gross national product
- **HIV**: human immunodeficiency virus
- **ILO**: International Labor Organization
- **IMR**: infant mortality rate
- **IPT**: intermittent preventative therapy
- **ITM**: insecticide treated material
- **LiST**: Lives Saved Tool
- **MDG**: millennium development goal
- **MMR**: maternal mortality ratio
- **MOH**: Ministry of Health
- **NACP**: national AIDS control program
- **NNMR**: neonatal mortality rate
- **ORT**: oral rehydration therapy
- **PTR**: perinatal transmission rate
- **STD**: sexually transmitted disease
- **TFR**: total fertility rate
- **TB**: tuberculosis
- **UNAIDS**: Joint United Nations Programme on HIV/AIDS
- **UNICEF**: United Nations Children’s Fund
- **USAID**: United States Agency for International Development
# 12. Coverage Indicator Definitions

## Included Interventions

<table>
<thead>
<tr>
<th>Periconceptual</th>
<th>Pregnancy</th>
<th>Child Birth/Immediate Postnatal</th>
<th>Preventive/Vaccines</th>
<th>Curative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contraception*</td>
<td>Case management during pregnancy (ANC)</td>
<td>Antenatal corticosteroids</td>
<td>Complementary feeding--education only</td>
<td>Oral antibiotic case management of severe infection in neonates</td>
</tr>
<tr>
<td>Folic acid supplementation or fortification</td>
<td>Syphilis detection and treatment (ANC)</td>
<td>Antibiotics for pRoM</td>
<td>Complementary feeding--supplementation and education</td>
<td>Injectable antibiotic case management of severe infection in neonates</td>
</tr>
<tr>
<td>Termination of pregnancy -D&amp;C, anesthesia</td>
<td>Calcium supplementation (ANC)</td>
<td>Essential delivery care for all women and immediate essential newborn care (FAC)</td>
<td>Use of an improved water source</td>
<td>Case management of severe infection in neonates with full supportive care</td>
</tr>
<tr>
<td>Termination of pregnancy -vacuum aspiration</td>
<td>IPTp malaria</td>
<td>Basic Emergency Obstetric Care (FAC)</td>
<td>Use of a water connection in the home</td>
<td>ORS</td>
</tr>
<tr>
<td>Termination of pregnancy -medical</td>
<td>Tetanus toxoid</td>
<td>Comprehensive Emergency Obstetric Care (FAC)</td>
<td>Improved excreta disposal (latrine/toilet)</td>
<td>Antibiotics for dysentery</td>
</tr>
<tr>
<td>Balanced energy supplementation</td>
<td>Active management of the third stage of labor (FAC)</td>
<td>Hand washing with soap</td>
<td>Zinc for treatment</td>
<td></td>
</tr>
<tr>
<td>Multiple micronutrient supplementation</td>
<td>Neonatal resuscitation (FAC)</td>
<td>Hygienic disposal of children's stools</td>
<td>Case management of pneumonia (oral antibiotics)</td>
<td></td>
</tr>
<tr>
<td>Case management of malaria (clinic and hospital)</td>
<td>Clean practices in non-facility birth and immediate essential newborn care (HOME)</td>
<td>Insecticide treated materials or indoor residual spraying (ITN/IRS)</td>
<td>Therapeutic feeding</td>
<td></td>
</tr>
<tr>
<td>HIV testing and treatment*</td>
<td>Neonatal resuscitation (HOME)</td>
<td>Vitamin A for prevention</td>
<td>Vitamin A for measles treatment</td>
<td></td>
</tr>
<tr>
<td>Kangaroo mother care</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*These interventions are linked into LiST from other Spectrum modules (FamPlan and AIM).

Gray and indented interventions indicates that they are part of a larger package of interventions which are typically delivered together. At the end of each such intervention is abbreviated the package (ANC=antenatal care; FAC=facility delivery; HOME=home delivery).
<table>
<thead>
<tr>
<th>Inputs</th>
<th>Value</th>
<th>Data Source</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infant mortality rate</td>
<td>IMR</td>
<td>WHO/UNICEF</td>
<td>Used UNICEF mortality data from the year of the most recent available survey.</td>
</tr>
<tr>
<td>Under 5 mortality rate</td>
<td>U5MR</td>
<td>WHO/UNICEF</td>
<td>Used UNICEF mortality data from the year of the most recent available survey.</td>
</tr>
<tr>
<td>Stunting</td>
<td>by age group; 0-1 month, 1-5 months, 6-11 months, 12-23 months, 24-59 months</td>
<td>Calculated from WHO or DHS</td>
<td>Height-for-age less than -2 Z-scores When WHO data was used, stunting was based upon standard deviations and WHO under 5 stunting values. For DHS data, 0-1 month: used &lt; 6 months 1-5 months: used &lt; 6 months 6-11 months: used 6-11 months 12-23 months: used 12-23 months 24-59 months: used 36-47 months</td>
</tr>
<tr>
<td>Wasting</td>
<td>by age group; 0-1 month, 1-5 months, 6-11 months, 12-23 months, 24-59 months</td>
<td>Calculated from WHO or DHS</td>
<td>Height-for-age less than -2 Z-scores When WHO data was used, stunting was based upon standard deviations and WHO under 5 stunting values. For DHS data, 0-1 month: used &lt; 6 months 1-5 months: used &lt; 6 months 6-11 months: used 6-11 months 12-23 months: used 12-23 months 24-59 months: used 36-47 months</td>
</tr>
<tr>
<td>Breast feeding</td>
<td>by age group; 0-1 month, 1-5 months, 6-11 months, 12-23 months, 24-59 months</td>
<td>Calculated from DHS or MICS data</td>
<td>Exclusive breast feeding, Predominant BF (+ water or liquids or juice) Partial BF (+ complementary foods and other milks), No breast feeding As the DHS categories do not match exactly the LiST categories, the center of the LiST period was chosen, if possible.</td>
</tr>
<tr>
<td>Inputs</td>
<td>Value</td>
<td>Data Source</td>
<td>Notes</td>
</tr>
<tr>
<td>--------</td>
<td>-------</td>
<td>-------------</td>
<td>-------</td>
</tr>
<tr>
<td>Diarrhea Incidence</td>
<td>by age group; 0-1 month, 1-5 months, 6-11 months, 12-23 months, 24-59 months</td>
<td>Boschi-Pinto C, Lanata C, Black R. The Global Burden of Childhood Diarrhoea. In: Ehiiri, John (Ed.). Maternal and Child Health: Global Challenges, Programs, and Policies. Springer Publishers, Washington DC, USA, 2009.</td>
<td>0-1 month: used &lt; 2 months 1-5 months: used 4-5 months 6-11 months: used 8-9 months 12-23 months: used 18-19 months 24-59 months: used the oldest available category, typically 34-35 months</td>
</tr>
<tr>
<td>Under 5 deaths by cause</td>
<td>14 causes</td>
<td>WHO/UNICEF 2000</td>
<td>Data are regional estimates based upon DHS data.</td>
</tr>
<tr>
<td>Maternal deaths by cause</td>
<td>11 causes</td>
<td>Modified from Khan et al, WHO analysis of maternal death: a systematic review. Lancet 2006 Apr 1;367(9516):1066-74.</td>
<td>Data are regional (African, Asian, South American) and have been adjusted to match the newest categories.</td>
</tr>
<tr>
<td>Inputs</td>
<td>Value</td>
<td>Data Source</td>
<td>Notes</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>IUGR</td>
<td>% of children born IUGR</td>
<td>Low Birth Weight: United Nations Children's Fund and World Health Organization, <em>Low Birthweight: Country, regional and global estimates</em>. UNICEF, New York, 2004. and <a href="http://www.childinfo.org/low_birthweight_profiles.php">http://www.childinfo.org/low_birthweight_profiles.php</a></td>
<td>Data on the percent of infants considered to be intra-uterine growth retarded (IUGR) is difficult to obtain without accurate information on gestational age and data reported in household surveys is often biased because only a select sample of babies are weighed. In 2004, WHO and UNICEF published adjusted birthweights which are used as the default in LiST. De Onis give a calculation of $Y = -3.2452 + 0.852X$ to calculate IUGR ($y$) from low birthweight ($X$), which excludes children who are pre-term as well as children who are IUGR but not LBW. Children who weigh less than 2000g at birth and are IUGR are less likely to benefit from the interventions which reduce IUGR births. It is estimated that 88.4% of all IUGR infants weigh between 2000 and 2499g. Default IUGR is 88.4% of calculated IUGR.</td>
</tr>
<tr>
<td>Vitamin A deficiency</td>
<td>0 or 1; Is the population Vitamin A deficient?</td>
<td><em>Lancet</em> 2008; 371: 243–60</td>
<td>In addition, China and Brazil are assumed to only have pockets of Vitamin A deficiency.</td>
</tr>
<tr>
<td>Zinc deficiency</td>
<td>0 or 1; Is the population zinc deficient?</td>
<td><a href="http://www.unu.edu/unupress/food/fnb25-1s-IZiNCG.pdf">www.unu.edu/unupress/food/fnb25-1s-IZiNCG.pdf</a></td>
<td>Where stunting and data from food balance sheets were not both available, zinc deficiency was assumed if either stunting rates were $&gt; 20%$ in children 18-59 months old or where food balance sheets predict a medium or high risk.</td>
</tr>
<tr>
<td>IPTp recommended</td>
<td>0 or 1</td>
<td>Malaria &amp; Children; Roll Back Malaria at <a href="http://www.unicef.org/health/files/Malaria0831.pdf">www.unicef.org/health/files/Malaria0831.pdf</a></td>
<td>By default, IPTp can only benefit populations where the government has recommended that IPTp be used.</td>
</tr>
<tr>
<td>Economic status</td>
<td>% of the population living on less than $1 per day</td>
<td>SOWC 2005, Table 7. Economic indicators.</td>
<td>Note that this only used to determine the percent of the population which can benefit from balanced energy supplementation (maternal) or complementary feeding education and supplementation. For the future, the percent of children living on less than $1.25$ can be used instead.</td>
</tr>
</tbody>
</table>
# Interventions, Indicators and Data Sources

<table>
<thead>
<tr>
<th>Interventions</th>
<th>Indicators</th>
<th>Baseline Data Source</th>
<th>Notes-Description</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Periconceptual period</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contraception*</td>
<td>see FamPlan</td>
<td>FamPlan Module in Spectrum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Folic acid supplementation or fortification</td>
<td>% of married women receiving folic acid supplementation tablet or fortification at conception</td>
<td>Assumed to currently be 0 in all countries</td>
<td>5.0 mg folic acid per day for three months for women attempting to become pregnant</td>
<td></td>
</tr>
<tr>
<td>Termination of pregnancy – D&amp;C, anaesthesia</td>
<td>% of terminations that are performed with D&amp;C and anesthesia</td>
<td>Set at 0 for baseline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Termination of pregnancy – vacuum aspiration</td>
<td>% of terminations that are performed with vacuum aspiration</td>
<td>Set at 0 for baseline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Termination of pregnancy - medical</td>
<td>% of terminations that are performed medically</td>
<td>Set at 0 for baseline</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Antenatal period</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antenatal care</td>
<td>% of pregnant women with at least 4 antenatal care visits</td>
<td>DHS or MPS WHR-05 if not available</td>
<td>This intervention has no impact itself. The components below are the interventions which impact mortality.</td>
<td></td>
</tr>
<tr>
<td>Case management during pregnancy</td>
<td>% of pregnant women who get at least 4 ANC visits.</td>
<td>These visits should include the following basic activities: screening and management of anemia, screening and management of hypertension; screening and management of pre-partum hemorrhage; screening and management of abnormal lie or twins.</td>
<td>ANC4</td>
<td></td>
</tr>
<tr>
<td>Syphilis detection and treatment</td>
<td>% of pregnant women screened for syphilis with the rapid plasma</td>
<td></td>
<td>if ANC4 &lt; 40%, then ANC4 *.2; ANC4 &lt; 75%, then ANC4 *.5; ANC4 &lt; 95% then ANC4 *.7; ANC4 &gt;= 95%, then ANC *.1.0</td>
<td></td>
</tr>
<tr>
<td>Interventions</td>
<td>Indicators</td>
<td>Baseline Data Source</td>
<td>Notes-Description</td>
<td>Formula</td>
</tr>
<tr>
<td>---------------</td>
<td>------------</td>
<td>----------------------</td>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Calcium Supplementation</td>
<td>% of pregnant women taking 1g of calcium per day</td>
<td>No data currently available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IPT malaria</td>
<td>% of pregnant women living in malaria endemic areas and receiving intermittent preventive treatment for malaria (2 doses of sulfadoxine-pyrimethamine)</td>
<td>MICS/DHS via Malaria and Children Report <a href="http://www.unicef.org/health/files/Malaria0831.pdf">www.unicef.org/health/files/Malaria0831.pdf</a></td>
<td>Only applies to countries with a program recommending IPTp and 1st or 2nd child</td>
<td></td>
</tr>
<tr>
<td>Tetanus toxoid</td>
<td>% of children protected at birth from tetanus (PAB)</td>
<td>WHO/UNICEF</td>
<td>% of women who received 2 doses of tetanus toxoid during this pregnancy or ever: Received at least 2 doses, the last within 3 years; Received at least 3 doses, the last within 5 years; Received at least 4 doses, the last within 10 years; Received at least 5 doses during lifetime. Also known as TT2+.</td>
<td></td>
</tr>
<tr>
<td>Balanced energy supplementation</td>
<td>% of undernourished pregnant women receiving high protein and calorie dietary supplements</td>
<td>set at 0 for baseline</td>
<td>The proxy chosen for undernourished pregnant women is the percent of the population living on less than a dollar a day.</td>
<td></td>
</tr>
<tr>
<td>Multiple micronutrient supplementation</td>
<td>% of pregnant women receiving micronutrient supplementation</td>
<td>set at 0 for baseline</td>
<td>The population at risk is all pregnant women. Multiple micronutrient supplementation is defined as receiving at least three micronutrients, typically including iron, folic acid, and another nutrient, often Vitamin A. Adequate receipt is for the duration of the pregnancy.</td>
<td></td>
</tr>
<tr>
<td>Case management of malaria</td>
<td>% of pregnant women with malaria who are treated for</td>
<td>Set at 0 for baseline</td>
<td>This is at a health center</td>
<td></td>
</tr>
<tr>
<td>Interventions</td>
<td>Indicators</td>
<td>Baseline Data Source</td>
<td>Notes-Description</td>
<td>Formula</td>
</tr>
<tr>
<td>---------------</td>
<td>------------</td>
<td>----------------------</td>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Case management of malaria</td>
<td>% of pregnant women with malaria who are treated for malaria at a hospital</td>
<td>Set at 0 for baseline</td>
<td>This is in a hospital.</td>
<td></td>
</tr>
<tr>
<td>HIV testing and treatment (maternal)**</td>
<td>see AIM</td>
<td>AIM Module in Spectrum</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Child Birth**

**Available data**

<table>
<thead>
<tr>
<th>Interventions</th>
<th>Indicators</th>
<th>Baseline Data Source</th>
<th>Notes-Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility based birth (InstDel)</td>
<td>% of infants delivered in a facility</td>
<td>DHS/MICS and MPS WHR-05, if otherwise unavailable</td>
<td>This intervention has no impact itself. The components below are the interventions which impact mortality. This is used to estimate coverage below.</td>
</tr>
<tr>
<td>Skilled birth attendance</td>
<td>% of infants delivered by a skilled birth attendant</td>
<td>DHS/MICS and MPS WHR-05, if otherwise unavailable</td>
<td>This intervention has no impact itself. The components below are the interventions which impact mortality. This is used to estimate coverage below.</td>
</tr>
</tbody>
</table>

**At onset of labor or risk of onset**

<table>
<thead>
<tr>
<th>Interventions</th>
<th>Indicators</th>
<th>Baseline Data Source</th>
<th>Notes-Description</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antenatal corticosteroids</td>
<td>Intramuscular injection of betamethasone sodium phosphate to women with suspected premature labor (6 mg, every 12 hours for 2 days) – target 2+ doses 12 hours before birth</td>
<td>InstDel &lt;30, InstDel*.1; InstDel &lt;50, InstDel*.2; InstDel &lt;95, InstDel*.5, InstDel &gt;=95,InstDel *.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antibiotics for pPRoM</td>
<td>Administration of oral erythromycin to women with premature rupture of membranes (PRoM) (250mg, 4 times daily for 7 days) who are not in labor to prevent PRoM</td>
<td>InstDel &lt;30, InstDel*.3; InstDel &lt;50, InstDel*.5, InstDel &lt;95, InstDel*.75,InstDel &gt;=95, InstDel*1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Labor, birth, and immediate postnatal period**

<table>
<thead>
<tr>
<th>Interventions</th>
<th>Indicators</th>
<th>Baseline Data Source</th>
<th>Notes-Description</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essential care for all women and immediate essential newborn care</td>
<td>% of women with essential care during delivery and immediate newborn care</td>
<td>This includes: monitoring labor progress with a partograph, detection of complications and infection control via a clean delivery. Episiotomy is available, if needed. For the neonate, this includes: immediate drying and wrapping, skin-to-skin contact and thermal care as well as immediate breastfeeding initiation</td>
<td>InstDel &lt;30, InstDel*.3; InstDel &lt;50, InstDel*.5, InstDel &lt;95, InstDel*.75; InstDel &gt;= 9, InstDel*1</td>
<td></td>
</tr>
<tr>
<td>Basic Emergency Obstetric Care</td>
<td>% of women with access to basic</td>
<td>This refers to management of delivery at a health center and covers case management of direct obstetric complications. The</td>
<td>InstDel &lt;30, InstDel*.1; InstDel &lt;50, InstDel*.5; InstDel &lt;95, InstDel*.75;</td>
<td></td>
</tr>
<tr>
<td>Interventions</td>
<td>Indicators</td>
<td>Baseline Data Source</td>
<td>Notes-Description</td>
<td>Formula</td>
</tr>
<tr>
<td>---------------</td>
<td>------------</td>
<td>----------------------</td>
<td>-------------------</td>
<td>---------</td>
</tr>
</tbody>
</table>
| emergency obstetric care, if needed | | | intervention includes:  
Case management of abortion, ectopic pregnancy, hypertensive diseases of pregnancy, antepartum hemorrhage, prolonged/obstructed labor, postpartum hemorrhage and severe infection. 
Methods include: shock management, MgSO4, pain relief, ABC, parenteral antibiotics, parenteral oxytocics, IV fluids, instrumental delivery and manual removal of the placenta and retained products., | InstDel >= 95, InstDel*1 |
| Comprehensive Emergency Obstetric Care | % of women with access to comprehensive emergency obstetric care, if needed | | This refers to management of delivery at a hospital and covers case management of direct obstetric complications. This is in addition to all interventions included in Basic Emergency Obstetric Care. This intervention includes:  
Case management of abortion, ectopic pregnancy, hypertensive diseases of pregnancy, antepartum hemorrhage, prolonged/obstructed labor, postpartum hemorrhage and severe infection  
Additional methods include: ultrasound, culdocentesis, induction, laparotomy, salpingectomy, blood transfusion, caesarian section, hysterectomy, symphysiotomy, balloon tamponade, uterine ligature, MRVOP, surgical infection control and episiotomy. | InstDel <30, InstDel*.1; InstDel <50, InstDel*.2; InstDel <95, InstDel*.6; InstDel >=95, InstDel * .8 |
<p>| Active management of third stage of labor | % of women with access to active management of the third stage of labor | Set at 0 for baseline | This includes controlled cord traction, oxytocics as well as massage. | InstDel &lt;30, InstDel*.1; InstDel &lt;50, InstDel*.2; InstDel &lt;95, InstDel*.6; InstDel &gt;=95, InstDel * .8 |
| Neonatal resuscitation (facility) | % of newborns with access to detection of breathing problems and resuscitation (with a bag and mask), if needed | | | InstDel &lt;30, InstDel*.1; InstDel &lt;50, InstDel*.2; InstDel &lt;95, InstDel*.6; InstDel &gt;=95, InstDel * .8 |
| Home Delivery | 1-% of infants born in any facility | fixed by % born in facility | This intervention has no impact itself. The components below are the interventions which impact mortality. | |
| Clean practices in non-facility birth and immediate, essential newborn care | % of women delivering at home with a clean delivery kit, including promotion of | | Need a definition. | SBA-Facility delivery |</p>
<table>
<thead>
<tr>
<th>Interventions</th>
<th>Indicators</th>
<th>Baseline Data Source</th>
<th>Notes-Description</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn resuscitation</td>
<td>% of women delivering at home with access to newborn resuscitation</td>
<td>Set at 0 for baseline</td>
<td>% of newborns with access to detection of breathing problems and resuscitation (with a mucus extractor), if needed</td>
<td></td>
</tr>
<tr>
<td>Immediate Postnatal care</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preventive postnatal care (healthy practices &amp; illness detection)</td>
<td>% of infants delivering at home with a postnatal health contact/visit within 2 days of birth</td>
<td>set at 0 for baseline</td>
<td>This intervention includes being counseled on breast feeding, clean cord care, skin hygiene and temperature control, as well as detection of illnesses and extra care for low birth weight infants.</td>
<td></td>
</tr>
<tr>
<td>Kangaroo mother care</td>
<td>% of low birth weight infants with access to kangaroo mother care</td>
<td>set at 0 for baseline</td>
<td>Kangaroo mother care is defined as: skin-to-skin contact between a mother and her newborn, frequent and exclusive breast feeding, and early discharge from the hospital. Not that this intervention only impacts deaths attributable to prematurity and must be given in a facility.</td>
<td></td>
</tr>
<tr>
<td>Active early detection of maternal and neonatal complications</td>
<td>% of mothers with a post-natal visit within 2 days</td>
<td>set at 0 for baseline</td>
<td>This intervention includes detection of post-partum hemorrhage, hypertensive disease of pregnancy and sepsis. This also includes detection of neonatal sepsis.</td>
<td></td>
</tr>
<tr>
<td>Postpartum hemorrhage reduction</td>
<td></td>
<td>set at 0 for baseline</td>
<td>This intervention includes nipple stimulation, rubbing of the uterus and discussion of breastfeeding.</td>
<td></td>
</tr>
<tr>
<td>PMTCT**</td>
<td>see AIM</td>
<td>AIM Module in Spectrum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breastfeeding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breastfeeding behavior</td>
<td>See breast feeding under national level data inputs</td>
<td>DHS or MICS</td>
<td>Note that this refers to the actual breastfeeding behavior, which can change based upon the age of the child as well as the observed/desired behavior.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The user can select to use either breastfeeding behavior or breastfeeding promotion as the breastfeeding indicator of choice.</td>
<td></td>
</tr>
<tr>
<td>Interventions</td>
<td>Indicators</td>
<td>Baseline Data Source</td>
<td>Notes-Description</td>
<td>Formula</td>
</tr>
<tr>
<td>---------------</td>
<td>------------</td>
<td>----------------------</td>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Breastfeeding promotion</td>
<td>% of mothers of children 0-11 months of age exposed to a breastfeeding promotion message</td>
<td>Baseline is percent of 1-5 month old children exclusively breastfed</td>
<td>Breastfeeding promotion can be either one-on-one or group meetings. It is assumed that children 1-5 months of age who are exclusively breast fed do not need breastfeeding promotion.</td>
<td></td>
</tr>
<tr>
<td>Preventive</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complementary feeding—education only</td>
<td>% of mothers intensively counseled on the importance of continued breast feeding after 6 months and appropriate complementary feeding practices</td>
<td>Set at 6-9 month old children receiving breastmilk and complementary feeding as baseline; See FAQ for notes on indicator selection.</td>
<td>This intervention only benefits children 6-24 months of age who are living on more than a dollar a day; This can be delivered in the home, community or clinic, by health professionals or health volunteers. It includes the assumption that breast feeding should be continued for children 6-24 months of age,(but does not affect breast feeding rates). The intervention includes education on the proper foods to prepare as well as appropriate hygiene for food preparation.</td>
<td></td>
</tr>
<tr>
<td>Complementary feeding—supplementation and education</td>
<td>% of mothers of malnourished infants who are intensively counseled on the importance of continued breast feeding after 6 months and appropriate complementary feeding practices as well as given appropriate supplements</td>
<td>set at 0 for baseline.</td>
<td>This intervention only benefits children 6-24 months of age who are living on less than a dollar a day; This can be delivered in the home, community or clinic, by health professionals or health volunteers. It includes the assumption that breast feeding should be continued for children 6-24 months of age,(but does not affect breast feeding rates). The intervention includes supplementation of child, ranging from 100-1500 kcal per day, typically including micronutrients. As well as education on the proper foods to prepare and appropriate hygiene for food preparation.</td>
<td></td>
</tr>
<tr>
<td>Use of water connection in the home</td>
<td>% of households with water piped into the home or yard</td>
<td>Childinfo.org (2006 estimate) or DHS/MICS</td>
<td>The baseline data was from ChildInfo.org. When a DHS/MICS was available closer to 2003, this was used instead</td>
<td></td>
</tr>
<tr>
<td>Use of improved water source within 30 minutes</td>
<td>% of homes with improved water</td>
<td>Childinfo.org (2006 estimate) or DHS/MICS</td>
<td>The baseline data was from ChildInfo.org. When a DHS/MICS was available closer to 2003, this was used instead. See <a href="http://www.unicef.org/wes/mdgreport/definition.php">www.unicef.org/wes/mdgreport/definition.php</a> for indicator</td>
<td></td>
</tr>
<tr>
<td>Interventions</td>
<td>Indicators</td>
<td>Baseline Data Source</td>
<td>Notes-Description</td>
<td></td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>------------------------------------------------</td>
<td>----------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Improved excreta disposal</td>
<td>% of homes with access to an improved latrine or flush toilet</td>
<td>Childinfo.org (2006 estimate) or DHS/MICS</td>
<td>The baseline data was from ChildInfo.org. When a DHS/MICS was available closer to 2003, this was used instead. See <a href="http://www.unicef.org/wes/mdgreport/definition.php">www.unicef.org/wes/mdgreport/definition.php</a> for indicator definitions.</td>
<td></td>
</tr>
<tr>
<td>Hand washing with soap</td>
<td>% of mothers washing their hands with soap appropriately</td>
<td>Curtis VA, Health Education Research, March 2009; all others set to 0</td>
<td>Appropriate hand washing is defined as washing hands with soap, ash or other materials and using adequate water, after handling feces and before preparing food. Reported hand washing is not an adequate indicator. Neither is availability of hand washing materials. Observational data is required.</td>
<td></td>
</tr>
<tr>
<td>Hygienic disposal of children’s stools</td>
<td>% of children whose fecal matter is adequately contained</td>
<td>DHS survey</td>
<td>Children’s tools are considered to be contained if 1) the child always uses a toilet/latrine, 2) the feces are thrown in a toilet/latrine, 3) the feces are buried in the yard</td>
<td></td>
</tr>
<tr>
<td>Insecticide treated materials or indoor residual spraying</td>
<td>% of households with at least 1 insecticide treated net or covered by indoor residual spraying</td>
<td>MICS/DHS via Malaria and Children Report <a href="http://www.unicef.org/health/files/Malaria0831.pdf">www.unicef.org/health/files/Malaria0831.pdf</a></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin A supplementation</td>
<td>% of children 6-59 months receiving full coverage with Vitamin A</td>
<td>Childinfo.org</td>
<td>Full coverage of Vitamin A supplementation is considered to be 2 doses of Vitamin A in the past year. See above definition of national Vitamin A deficiency. It is assumed that all children in a country with Vitamin A deficiency are in need of Vitamin A for prevention.</td>
<td></td>
</tr>
<tr>
<td>Zinc for prevention</td>
<td>% of children 6-59 months supplemented daily with zinc</td>
<td>set at 0 for baseline</td>
<td>Daily supplementation with 10mg zinc. It is assumed that all children in a country with zinc deficiency are in need of zinc for prevention. See above definition of national zinc deficiency.</td>
<td></td>
</tr>
</tbody>
</table>

**Vaccinations**

<table>
<thead>
<tr>
<th>Vaccinations</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotavirus vaccine</td>
<td>Proportion of infants having received 3 doses of rotavirus vaccine prior to the survey</td>
<td>set at 0 for baseline</td>
<td>Not yet implemented in countries routinely</td>
</tr>
<tr>
<td>Measles vaccine</td>
<td>Proportion of</td>
<td>UNICEF</td>
<td></td>
</tr>
<tr>
<td>Interventions</td>
<td>Indicators</td>
<td>Baseline Data Source</td>
<td>Notes-Description</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------</td>
<td>------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>infants having received 2 dose of measles containing vaccine (MCV) prior to the survey</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Proportion of infants having received 3 doses of Haemophilis influenza type B vaccine prior to the survey</td>
<td>UNICEF</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Proportion of infants having received 3 doses of pneumococcal vaccine prior to the survey</td>
<td>set at 0 for baseline</td>
<td>Will be implemented in some countries routinely in 2009.</td>
</tr>
<tr>
<td></td>
<td>Proportion of infants having received 3 doses of diphtheria, tetanus and pertussis vaccine prior to the survey</td>
<td>UNICEF</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Proportion of infants having received 3 doses of polio vaccine prior to the survey</td>
<td>UNICEF</td>
<td>Polio vaccine has no impact on mortality of children less than 5 years of age.</td>
</tr>
<tr>
<td></td>
<td>Proportion of infants having received 1 dose of BCG vaccine prior to the survey</td>
<td>UNICEF</td>
<td>BCG vaccine has no impact on cause specific mortality of children less than 5 years of age.</td>
</tr>
<tr>
<td>Curative</td>
<td>Proportion of neonates with suspected</td>
<td>Set at 0 or ½ of case management of</td>
<td></td>
</tr>
<tr>
<td>Interventions</td>
<td>Indicators</td>
<td>Baseline Data Source</td>
<td>Notes-Description</td>
</tr>
<tr>
<td>---------------</td>
<td>---------------------------------------------------------------------------</td>
<td>----------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>in neonates</td>
<td>pneumonia, sepsis or ARI in the 2 weeks preceding the survey treated with antibiotics</td>
<td>pneumonia, for baseline</td>
<td></td>
</tr>
<tr>
<td>Injectable antibiotic case management of severe infection in neonates</td>
<td>Proportion of neonates</td>
<td>Set at 0 for baseline</td>
<td></td>
</tr>
<tr>
<td>Case management of severe infection in neonates with full supportive care</td>
<td>Proportion of neonates with serious infections with oxygen, IV antibiotics, IV fluids, blood transfusion, phototherapy, etc. available</td>
<td>set as a function of facility births</td>
<td>Facility based care only</td>
</tr>
<tr>
<td>Case management of pneumonia (oral antibiotics)</td>
<td>Proportion of children 1-59 months with suspected pneumonia or ARI treated with antibiotics</td>
<td>Childinfo.org; DHS</td>
<td>This is not available for many recent DHS surveys.</td>
</tr>
<tr>
<td>ORS</td>
<td>% of children with diarrhea given ORS from sachets</td>
<td>DHS</td>
<td>This includes sachets or pre-mixed solutions of ORS.</td>
</tr>
<tr>
<td>Antibiotics for dysentery</td>
<td>% of children with dysentery treated with antibiotics</td>
<td>set at case management for pneumonia, if available, otherwise 50% of ORS</td>
<td>Typical treatment is 3 days of 250mg of ciprofloxacin. This data is typically not available. Use DHS data if available.</td>
</tr>
<tr>
<td>Zinc for treatment</td>
<td>% of children 0-59 months with diarrhea receiving zinc supplementation</td>
<td>set at 0 for baseline</td>
<td>20mg of zinc supplementation daily for 14 days</td>
</tr>
<tr>
<td>Therapeutic feeding</td>
<td>% of wasted children receiving therapeutic</td>
<td>Set at 0 for baseline</td>
<td>Therapeutic feeding is inpatient treatment including antibiotics, supplementation with food and maternal education.</td>
</tr>
<tr>
<td>Interventions</td>
<td>Indicators</td>
<td>Baseline Data Source</td>
<td>Notes-Description</td>
</tr>
<tr>
<td>---------------</td>
<td>------------</td>
<td>----------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Vitamin A for measles treatment</td>
<td>% of measles cases treated with Vitamin A</td>
<td>Set at the percent of children receiving 2 doses of Vitamin A, UNICEF, as baseline</td>
<td>Typical treatment is 2 days of Vitamin A supplementation, ranging from 50,000 IU to 200,000 IU, based upon the age of the child. This information is not typically available.</td>
</tr>
<tr>
<td>Antimalarials</td>
<td>Proportion of children 0-59 months with a fever receiving any appropriate anti-malarial</td>
<td>Childinfo.org</td>
<td>This data is from the DHS surveys.</td>
</tr>
<tr>
<td>Cotrimoxazole**</td>
<td>see AIM</td>
<td>AIM Module in Spectrum</td>
<td></td>
</tr>
<tr>
<td>Child ART**</td>
<td>see AIM</td>
<td>AIM Module in Spectrum</td>
<td></td>
</tr>
</tbody>
</table>

Gray text indicates that coverage is not estimated directly but is calculated with respect to another indicator.
Overview of the LiST model

LiST uses a simple cohort model which follows children through five age bands from birth to five years (Table 1) to estimate the number of neonatal and child deaths that could be prevented by different interventions. The model estimates the number of children who die from specific causes in each age band. The model also estimates the impact of interventions on several intermediate health outcomes. These include the proportion of children born with intra-uterine growth restriction (IUGR), the subsequent nutritional status of children, as measured by height-for-age z-score (HAZ) and weight-for-height z-score (WHZ), and diarrhea incidence.

<table>
<thead>
<tr>
<th>Age band</th>
<th>Causes of death acting during age band</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth to 0.9 months</td>
<td>Birth asphyxia, prematurity, sepsis/pneumonia, congenital anomalies, tetanus, diarrhea, other</td>
</tr>
<tr>
<td>1 – 5.9 months</td>
<td>Diarrhea, pneumonia, measles, malaria, AIDS, other</td>
</tr>
<tr>
<td>6 – 11.9 months</td>
<td></td>
</tr>
<tr>
<td>12 – 23.9 months</td>
<td></td>
</tr>
<tr>
<td>24 – 59.9 months</td>
<td></td>
</tr>
</tbody>
</table>

Interventions may affect mortality directly or indirectly, by changing the risk status of children. Since LiST is a model for estimating the impact of scaling up interventions, LiST estimates reductions in mortality rather than the absolute risk of mortality. LiST communicates the percent decline in mortality risk to a demographic projection module (DemProj) which in turn calculates survival rates and mortality rates that are applied to the relevant population cohorts. Most of the discussion below describes how the reductions in mortality and improvements in risk status are estimated. Following these descriptions are brief discussions of special topics in LiST including intra-uterine growth retardation (IUGR), immunizations, breastfeeding and therapeutic feeding.

Figure 1 presents a summary schematic of the risk factors in LiST. Along the left edge of the diagram are several categories of interventions. The most numerous of these interventions are those with a direct impact on mortality in LiST (described in Section B). The next most numerous interventions in the model are maternal and child nutrition interventions (described in Sections C, D, E and H). These interventions affect intermediate risk factors including height for age, weight for height and the prevalence of intra-uterine growth retardation. Since LiST is a cohort model previous nutritional status affects current nutrition status. This is shown in the diagram by the sequentially presented boxes for height for age at times “t-1” and “t”. A third set of interventions are for water and sanitation. Scale up of these interventions reduces diarrhea incidence which in
turn improves the nutritional status of children (described in Section I) as well as reducing diarrhea mortality directly.

**Figure 1: Schematic of Risk Factors in the LiST Model**
Calculating the direct mortality impact of changes in coverage of an intervention

LiST calculates the impact of changes in coverage of an intervention under the assumption that the number (proportion) of deaths averted increases linearly with coverage as coverage increases from 0 to 100 percent. LiST uses this assumption in the current absence of data to support a more complex function to describe the relationship. Furthermore, LiST assumes that interventions have multiplicative effects; i.e., interventions reduce cause-specific mortality by a fixed relative amount rather than a fixed absolute amount. Given these assumptions, the percent reduction in cause specific cohort mortality expected for a given cause of death by a given intervention is calculated in equation 1. Note that the percent reduction calculated in equation 1 is the percent reduction that would be expected if no other intervention were acting on the particular cause of death. If other interventions were scaled up, the impact of the intervention would be less. This effect is explained further in the discussion that follows.

1) \[
\%\text{RedMort}_{ij} = \left\{ I_{ij} \times (P_{jt} - P_{j0}) \right\} / (1 - I_{ij} \times P_{j0})
\]

where \[
\%\text{RedMort}_{ij} = \text{\% reduction in mortality from cause } i \text{ by intervention } j
\]

\[
I_{ij} = \text{effectiveness of intervention } j \text{ in reducing mortality from cause } i
\]

\[
P_{j0} = \text{baseline coverage of the intervention } j
\]

\[
P_{jt} = \text{target coverage for the intervention } j
\]

This equation is derived as follows. If the death rate at 0% coverage is \(m_0\), then the death rate at 100 percent coverage is \(m_0 \times (1 - I)\). For any given coverage \(P\), the death rate can be written as: death rate = \(m_0 \times (1 - P \times I)\). Then, at current coverage \(P_0\), the current death rate, \(m = m_0 \times (1 - P_0 \times I)\) and so \(m_0 = m / (1 - P_0 \times I)\). Increasing coverage to \(P_t\) will reduce the death rate to \(m_0 \times (1 - P_t \times I)\). Therefore, the percent reduction in the death rate by increasing coverage from \(P_0\) to \(P_t\) will be \(m_0 \times (1 - P_0 \times I) - m_0 \times (1 - P_t \times I) = m_0 \times I \times (P_t - P_0)\), and substituting \(m\) (current death rate) for \(m_0\), produces the formula above for death rate reduction.

A slight complication to equation 1 corrects for the proportion of the deaths from cause \(i\) that is due to the specific condition addressed by intervention \(j\) (or affected fraction). The adjusted equation is:

2) \[
\%\text{RedMort}_{ij} = \left\{ I_{ij} \times (P_{jt} - P_{j0}) \times AF_{ij} \right\} / (1 - I_{ij} \times P_{j0})
\]

where \(AF_{ij} = \text{affected fraction for intervention } j \text{ on cause of death } i\).

Rotavirus vaccine is an example where the affected fraction is important. Rotavirus vaccine is 95 percent effective in preventing diarrhea mortality caused by rotavirus. In LiST the default setting for the affected fraction of rotavirus is 0.27; i.e. it is assumed that 27 percent of diarrhea mortality is due to diarrhea caused by the rotavirus. Without the correction for the affected fraction the rotavirus vaccine would project a 95 percent reduction in diarrhea mortality while the actual upper bound is actually about 25.7 percent.

The proportion of deaths prevented is calculated for each intervention, for each cause of death and each age band. For each cohort, survival across all age bands is then computed.
To avoid double counting of lives saved/deaths averted, the model calculates the impact of each intervention iteratively one after another, with the impact of second intervention being calculated using the deaths remaining after the effect of the first intervention has been computed and so on. For example, suppose that we have 100 child deaths and assume that the scale up of intervention A reduces prevents 10% of these while scale up of intervention B prevents 20% of deaths. The combination of interventions A and B will then prevent 28% rather than 30% of deaths.

Therefore, the total reduction in cause specific mortality for a cohort is the following:

\[
\text{\%RedMort}^i_{\text{total}} = 1 - (1-\text{\%RedMort}^i_{\text{nutrition}}) \times (1-\text{\%RedMort}^a_i) \times (1-\text{\%RedMort}^b_i) \ldots (1-\text{\%RedMort}^z_i)
\]

The percent reduction in mortality due to nutrition/risk factor improvements, \(\text{\%RedMort}^i_{\text{nutrition}}\), whose calculation is described below, is treated as if it were an intervention in this equation.

Preventive interventions, including nutrition interventions when effective will reduce the need for treatment. Therefore in LiST preventive interventions are assumed to have priority in impact over the curative interventions. The interventions are passed through the calculation process in two separate groups. First the impact of preventive interventions is calculated using the iterative process. This establishes the impact of preventive interventions on cause specific mortality. The impact of the curative interventions is the difference between total cause specific mortality reduction and the cause specific mortality reduction due to the preventive interventions.

\[
\text{\%RedMort}^i_{\text{preventive}} = 1 - (1-\text{\%RedMort}^i_{\text{nutrition}}) \times (1-\text{\%RedMort}^a_i) \times (1-\text{\%RedMort}^b_i) \ldots (1-\text{\%RedMort}^m_i)
\]

where interventions a through m are preventive interventions.

\[
\text{\%RedMort}^i_{\text{curative}} = \text{\%RedMort}^i_{\text{total}} - \text{\%RedMort}^i_{\text{preventive}}
\]

LiST establishes the individual impact of interventions by assigning weights to each of the intervention impacts and applying them to the percent of deaths prevented by preventive and curative interventions as appropriate. The weights are calculated by these equations:

\[
\text{WT}^i_{\text{preventive}} = \text{\%RedMort}^i_i / (\text{\%RedMort}^i_{\text{nutrition}} + \text{\%RedMort}^a_i + \text{\%RedMort}^b_i \ldots + \text{\%RedMort}^m_i)
\]

\[
\text{WT}^i_{\text{curative}} = \text{\%RedMort}^i_i / (\text{\%RedMort}^i_{\text{nutrition}} + \text{\%RedMort}^a_i + \text{\%RedMort}^b_i \ldots \text{\%RedMort}^z_i)
\]

The proportion of cause specific deaths prevented by a particular intervention is then:

\[
\text{\%ActualRedMort}^i_{\text{preventive}} = \text{\%RedMort}^i_{\text{preventive}} \times \text{WT}^i_{\text{preventive}}
\]

\[
\text{\%ActualRedMort}^i_{\text{curative}} = \text{\%RedMort}^i_{\text{curative}} \times \text{WT}^i_{\text{curative}}
\]

The total mortality reduction for a given cohort is the sum of the cause specific reductions in mortality weighted by the baseline percent of deaths caused by the disease.
\[
\text{LiST MANUAL}
\]

10) \[ %\text{RedMort}^{\text{Total}} = %\text{Deaths}_0 \cdot %\text{RedMort}_1^{\text{Total}} + %\text{Deaths}_0 \cdot %\text{RedMort}_2^{\text{Total}} + \ldots + %\text{Deaths}_0 \cdot %\text{RedMort}_n^{\text{Total}}. \]

The preceding equations are perhaps difficult to understand without context. Table 2 works through an example using equations 1 through 9 with four interventions to reduce diarrhea mortality. Lines 1 through 4 in the table describe coverage levels, effectivenesses and affected fractions for the interventions. Rotavirus and improved water source are preventive interventions. Antibiotics and oral rehydration solution (ORS) are curative interventions. Using equation 2, the mortality reduction due to rotavirus vaccine in the absence of any other interventions would be:

\[
%\text{RedMort} = 0.95 \cdot (0.95 - 0.25) \cdot 0.27 / (1 - 0.95 \cdot 0.25) = 0.235
\]

The mortality reduction calculations are the same for the other four interventions. The total mortality reduction is calculated with equation 3:

\[
%\text{RedMort}^{\text{Total}} = 1 - (1 - 0.235) \cdot (1 - 0.032) \cdot (1 - 0.016) \cdot (1 - 0.513) = 0.645
\]

The mortality reduction due to preventive interventions is calculated with equation 4:

\[
%\text{RedMort}^{\text{Preventive}} = 1 - (1 - 0.235) \cdot (1 - 0.032) = 0.260
\]

The mortality reduction due to curative interventions is calculated with equation 5:

\[
%\text{RedMort}^{\text{Curative}} = 0.645 - 0.260 = 0.386
\]

The weights for apportioning the impact of the preventive and curative interventions are calculated with equations 6 and 7. The following shows the calculation of the weight for the impact of rotavirus vaccine, a preventive intervention:

\[
Wt = 0.235 / (0.235 + 0.032) = 0.881
\]

The mortality reduction due to a specific intervention is then calculated with either equation 8 or 9. The following shows the calculation of the impact of rotavirus:

\[
%\text{ActualRedMort} = 0.881 \cdot 0.260 = 0.229
\]
Table 2: Calculation of mortality reduction, example

<table>
<thead>
<tr>
<th></th>
<th>Rotavirus vaccine</th>
<th>Improved water source</th>
<th>Antibiotics</th>
<th>Oral Rehydration Solution</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial coverage</td>
<td>0.250</td>
<td>0.500</td>
<td>0.250</td>
<td>0.500</td>
<td></td>
</tr>
<tr>
<td>Target coverage</td>
<td>0.950</td>
<td>0.750</td>
<td>0.500</td>
<td>0.950</td>
<td></td>
</tr>
<tr>
<td>Effectiveness</td>
<td>0.950</td>
<td>0.120</td>
<td>0.980</td>
<td>0.750</td>
<td></td>
</tr>
<tr>
<td>Affected fraction</td>
<td>0.270</td>
<td>1.000</td>
<td>0.050</td>
<td>0.950</td>
<td></td>
</tr>
</tbody>
</table>

|                               | 0.235             | 0.032                 | 0.016       | 0.513                     | 0.645 |

|                               | Mortality reduction | Mortality reduction – preventive | Mortality reduction – curative | 0.260 | 0.386 |

|                               | 0.881             | 0.119 | |

|                               | Weights - preventive interventions | | 0.031 | 0.969 |

|                               | Weights - curative interventions | |

|                               | 0.229 | 0.031 | 0.012 | 0.374 | 0.645 |

**Nutritional status and its impact on mortality risk**

Most nutrition interventions do not have a direct impact on mortality. Instead the nutrition interventions affect nutritional status (or risk status) which in turn impacts the risk of mortality. LiST uses two nutritional status indicators – height for age (stunting) and weight for height (wasting). The following describes the process through which a height for age distribution is calculated and how height for age affects mortality. LiST estimates the distribution of height-for-age z-scores (HAZ) who survive to the end of the age band. The HAZ distribution is then one of the inputs to the HAZ calculations for the next age band and affects the risk of mortality in the subsequent age band. Thus, the HAZ distribution is both an output of the model and a risk factor for post-neonatal causes of mortality within the model.

To simplify the model enough to handle multiple interventions, LiST first estimates reductions in stunting – children below -2SD in HAZ. The model includes four factors that affect stunting: reduced intra-uterine growth retardation or stunting at the end of the previous cohort, complementary feeding, incidence of diarrhea and zinc supplementation. In contrast to the simple
risks used in the discussion of the direct impact of interventions on mortality, the impact of these factors is modeled as odds ratios.

In general the percent reduction in the odds of stunting from an improvement in one of the factors is the following:

11) \( \% \text{RedOddsRatio}_{i,t} = 1 - (\text{AvgOddsRatio}_{i,t} / \text{AvgOddsRatio}_{i,0}) \)

where \( \% \text{RedOddsRatio}_{i,t} \) = percent by which improvements in factor \( j \) reduces the average odds ratio of stunting in a given cohort

\( \text{AvgOddsRatio}_{i,t} \) = population averaged odds ratios of the states a factor may take on

Where \( \text{AvgOddsRatio}_{i,j} \) is calculated:

12) \( \text{AvgOddsRatio}_{i,j} = %\text{Status}^1_t * 1.00 + %\text{State}^2_t * \text{OddsRatio}^2 + %\text{State}^3_t * \text{OddsRatio}^3 + \ldots + %\text{State}^k_t * \text{OddsRatio}^k \)

where \( %\text{State}^k_t = \) percent of the cohort in state \( k \) at time \( t \)

\( \text{OddsRatio}^k = \) is the probability of being stunted in state \( k \) divided by the probability of being stunted in a healthy state 1

Rearranging equation 11 and applying the definition of odds yields a relatively simple equation for calculating the level of stunting that would ensue if there was only one intervention:

13) \( \text{Stunting}_{i,t} = \{\text{Odds}_{\text{stunting},0} * (\text{AvgOddsRatio}_{i,t} / \text{AvgOddsRatio}_{i,0}) / [1 + \{\text{Odds}_{i,0} * (\text{AvgOddsRatio}_{i,t} / \text{AvgOddsRatio}_{i,0})\}] \)

where \( \text{Odds}_{\text{stunting},0} = \) the odds of stunting at the baseline

The percent reduction in stunting that would occur in the absence of any other interventions is then calculated:

14) \( \% \text{RedStunting}_{i,t} = (\text{Stunting}_{i,0} - \text{Stunting}_{i,t}) / \text{Stunting}_{i,0} \)

As mentioned above one of the factors contributing to the reduction in stunting is the HAZ scores at the end of the previous cohort or in the case of the 0-1 month cohort the proportion of children with IUGR at birth. Via this mechanism, nutrition interventions scaled up for a given cohort at a given time have an impact in the current period on the given cohort as well as impact in subsequent time periods for older cohorts.

The total reduction in stunting for a given cohort is calculated similarly to how the direct intervention impacts were calculated.

15) \( \% \text{RedStunting}_{i} = 1 - (1- \% \text{RedStunting}_{i,1}) * (1- \% \text{RedStunting}_{i,2}) \ldots * (1- \% \text{RedOStunting}_{i}) \)

The percent of children in a given cohort who are stunted is then calculated by:

16) \( \% \text{Stunted}_{i,t} = \% \text{Stunted}_{i} * (1 - \% \text{RedStunting}_{i}) \)
The proportion by which the improvement in a given factor contributes to the reduction in stunting is the following:

17) \( \%\text{PropRedStunting} = \%\text{RedStunting} \times \left( \frac{\%\text{RedStunting}}{1 + \%\text{RedStunting} + \%\text{RedStunting}^2 + \ldots + \%\text{RedStunting}^j} \right) \)

Complementary feeding is treated differently than the nutrition interventions as there are two complementary feeding interventions in LiST – nutrition education and nutrition education plus supplementation. Nutrition education alone is assumed to be sufficient in households where people are living above the poverty level (defined as living on more than $1 per person per day). In households living below the poverty level, to achieve any impact children must receive a complementary feeding intervention that includes both education and supplementation.

Tables 3 and 4 work through examples of how improved complementary feeding and reduced stunting are used to calculate reductions in the odds of stunting. The results of these calculations are used to show how the reduction in the odds of stunting is converted into reduction in stunting for a given cohort. In Table 3 there are four states related to complementary feeding. Each is associated with an odds ratio of stunting relative to living in a food secure household where complementary feeding promotion has occurred.

The first five lines of Table 3 are inputs to the model. The overall odds ratios of stunting in the population at baseline and the target year are calculated as weighted averages. At baseline the calculation using equation 12 is:

\[ \text{AvgOddsRatio} = 1.000 \times 0.100 + 1.430 \times 0.300 + 1.600 \times 0.300 + 2.390 \times 0.400 = 1.965 \]

Using equation 13, the stunting that would ensue if complementary feeding were the only intervention is:

\[ \text{Stunting} = \frac{0.429 \times (1.800/1.965)}{1 + \{0.429 \times (1.800/1.965)\}} = 0.282 \]

The percent reduction in stunting that would ensue if complementary feeding were the only intervention is:

\[ \%\text{RedStunting} = (0.300 - 0.282)/0.300 = 0.060 \]
**Table 3: Reduction in the odds of stunting from an improvement in complementary feeding**

<table>
<thead>
<tr>
<th></th>
<th>Food secure with promotion</th>
<th>Food secure without promotion</th>
<th>Food insecure without promotion and supplementation</th>
<th>Food insecure with neither promotion nor supplementation</th>
<th>Total/ average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stunting at Baseline</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.300</td>
</tr>
<tr>
<td>Odds of stunting</td>
<td>1.000</td>
<td>1.430</td>
<td>1.600</td>
<td>2.390</td>
<td></td>
</tr>
<tr>
<td>Distribution of states at baseline</td>
<td>0.100</td>
<td>0.300</td>
<td>0.300</td>
<td>0.400</td>
<td>1.000</td>
</tr>
<tr>
<td>Distribution of states at target year</td>
<td>0.300</td>
<td>0.100</td>
<td>0.400</td>
<td>0.300</td>
<td>1.000</td>
</tr>
<tr>
<td>Average odds ratio at baseline</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.965</td>
</tr>
<tr>
<td>Average odds ratio at target year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.800</td>
</tr>
<tr>
<td>Stunting at target year in absence of other interventions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.282</td>
</tr>
<tr>
<td>Percent reduction in stunting in absence of other interventions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.060</td>
</tr>
</tbody>
</table>

Table 4 replicates the calculations in Table 3 except it calculates the reduction in stunting due to stunting in a previous cohort.

**Table 4: Reduction in the odds of stunting from reducing stunting in the previous cohort**

<table>
<thead>
<tr>
<th></th>
<th>Not stunted at previous cohort</th>
<th>Stunted at previous cohort</th>
<th>Total/ average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stunting at Baseline</td>
<td>0.300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Odds of stunting</td>
<td>1.000</td>
<td>21.400</td>
<td></td>
</tr>
<tr>
<td>Distribution of statuses at baseline</td>
<td>0.400</td>
<td>0.600</td>
<td>1.000</td>
</tr>
<tr>
<td>Distribution of statuses at target year</td>
<td>0.600</td>
<td>0.400</td>
<td>1.000</td>
</tr>
<tr>
<td>Average odds ratio at baseline</td>
<td></td>
<td></td>
<td>13.240</td>
</tr>
<tr>
<td>Average odds ratio at target year</td>
<td></td>
<td></td>
<td>9.160</td>
</tr>
<tr>
<td>Stunting at target year in absence of other interventions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent reduction in stunting in absence of other interventions</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 5 combines the percent reduction in the odds of stunting from tables 3 and 4 to calculate a new level of stunting in the cohort. The total percent reduction in stunting is calculated with equation 15:

\[ \text{%RedStunting}_t = 1 - (1 - 0.238) * (1 - 0.60) = 0.284 \]

Then the target year stunting is calculated by equation 16:

\[ \text{%Stunted}_t = 0.300 * (1 - 0.284) = 0.215 \]

**Table 5: Reduction in the odds of stunting from reducing stunting in the previous cohort**

<table>
<thead>
<tr>
<th></th>
<th>0.300</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline stunting</td>
<td></td>
</tr>
<tr>
<td>Percent reduction in stunting due to complementary feeding</td>
<td>0.060</td>
</tr>
<tr>
<td>Percent reduction in stunting due to reduced stunting in the previous cohort</td>
<td>0.238</td>
</tr>
<tr>
<td>Total percent reduction in stunting</td>
<td>0.284</td>
</tr>
<tr>
<td>Target year stunting</td>
<td>0.215</td>
</tr>
</tbody>
</table>

The calculation of the percent of children who are wasted is roughly the same except that only one intervention impacts wasting in the model – therapeutic feeding. Since wasting is considered an acute rather than a chronic condition, the level of wasting in a given cohort does not impact the risk of wasting in subsequent cohorts.

**Impact of improved nutritional status on mortality**

LiST assumes that HAZ and WHZ scores are normally distributed. Figure 2 shows the distribution of Z scores in an illustrative case (where stunting is defined as height for age of < 2 SD relative to the international standard). The curve on the right represents the international standard. The curve on the left represents the illustrative case. In the international standard the percent of children who are stunted is a relatively small proportion (2.5%) of the population in the left hand tail of the distribution. In the illustrative case, approximately 50 percent of the children are stunted. The vertical bars under the curve on the left show the points in the distribution that correspond to -1 SD, -2 SD and -3 SD in the international standard. LiST calculates the percent of children falling into four bands of the distribution are < -3 SD, -3 to <-2 SD, -2 to -1 SDs and above -1 SDs on HAZ relative to international standard based on an extrapolation from the percent of children who are less than -2 SD (calculated above).
LiST calculates the percent reduction in mortality with the following equation:

\[
\%\text{RedMort}_{i,\text{stunting}} = \frac{(\text{AvgRelRisk}_{i,\text{HAZ}_0} - \text{AvgRelRisk}_{i,\text{HAZ}_t})}{(\text{AvgRelRisk}_{i,\text{HAZ}_0} - 1)}
\]

where \(\%\text{RedMort}_{i,\text{stunting}}\) is the percent reduction in mortality for cause \(i\) resulting from an improvement in stunting statuses.

\[
\text{AvgRelRisk}_{i,\text{HAZ}_t} = \%\text{Status}_{a} * 1.00 + \%\text{Status}_{b} * \text{RelRisk}_{i,b} + \%\text{Status}_{c} * \text{RelRisk}_{i,c} + \%\text{Status}_{d} * \text{RelRisk}_{i,d}
\]

Where:

\(\text{RelRisk}_{i,b/c/d}\) is the risk of mortality in status \(b\) or \(c\) or \(d\) divided by the risk of mortality among children who are over -1 SD in height for age (a > -1 SD HAZ, -2SD < b < -1 SD, -3 SD < c < -2 SD, d < -3 SD)

\(\%\text{RedMort}_{i,\text{stunting}}\) is used in equation 3 for calculating the total reduction in mortality for cause \(i\).

Table 6 works through an example of how the percent reduction in mortality from improved height for age distribution is calculated. The average relative risk at baseline is calculated as:

\[
\text{AvgRelRisk} = (0.350 * 4.20) + (0.300 * 1.600) + (0.250 * 1.200) + (0.100 * 1.000) = 2.350
\]

\[
\%\text{RedMort}_{\text{stunting}} = \frac{(2.350 - 1.860)}{(2.350 - 1.000)} = 0.363
\]
### Table 6: Reduction in the mortality from improved height for age

<table>
<thead>
<tr>
<th></th>
<th>Baseline Distribution</th>
<th>Target year Distribution</th>
<th>Relative risk</th>
<th>Total/Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than -3 STD</td>
<td>0.350</td>
<td>0.200</td>
<td>4.200</td>
<td></td>
</tr>
<tr>
<td>Between -3 and -2 STD</td>
<td>0.300</td>
<td>0.250</td>
<td>1.600</td>
<td></td>
</tr>
<tr>
<td>Between -2 and -1 STD</td>
<td>0.250</td>
<td>0.350</td>
<td>1.200</td>
<td></td>
</tr>
<tr>
<td>Greater than -1 STD</td>
<td>0.100</td>
<td>0.200</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>Baseline average relative risk</td>
<td></td>
<td></td>
<td>2.350</td>
<td></td>
</tr>
<tr>
<td>Target year average relative risk</td>
<td></td>
<td></td>
<td>1.860</td>
<td></td>
</tr>
<tr>
<td>Percent reduction in cause specific mortality</td>
<td></td>
<td></td>
<td>0.363</td>
<td></td>
</tr>
</tbody>
</table>

The percent by which the improvement in a given factor decreases a cause specific mortality is given by the following equation:

\[
\%\text{ActualRedMort}_{i,j(\text{nutrition})} = \%\text{ActualRedMort}_{i,\text{nutrition}} \times \%\text{PropRedStunting}_{j}
\]

where \(\%\text{ActualRedMort}_{i,j(\text{nutrition})}\) is the percent by which nutrition intervention \(j\) reduces mortality from cause \(i\) in time \(t\).

#### Intrauterine Growth Retardation

LiST assumes that reductions in Intrauterine Growth Retardation (IUGR) reduce mortality directly in the neonatal period and reduce mortality indirectly via its link to stunting among children at the end of the neonatal period. In LiST increased coverage of maternal nutrition interventions and intermittent preventive therapy (IPT) will reduce IUGR. The calculation procedure is essentially the same as that for health interventions' impact on mortality. The independent impact of any intervention on IUGR is calculated as:

\[
\%\text{RedIUGR}_j = I_j \times (P_{j0} - P_{jt}) / (1 - I_j \times P_{j0})
\]

where \(\%\text{RedIUGR}_j\) = percent of reduction in IUGR due to intervention, \(j\)

\(I_j\) = proportion by which intervention reduces IUGR, \(j\)

\(P_{j0}\) = baseline coverage of the intervention, \(j\)

\(P_{jt}\) = target coverage for the intervention, \(j\)

Again similar to the calculations for health interventions the total impact on IUGR is calculated sequentially:

\[
\%\text{RedIUGR}^{\text{TOTAL}} = 1 - (1 - \%\text{RedIUGR}^a) \times (1 - \%\text{RedIUGR}^b) \times (1 - \%\text{RedIUGR}^c) \times \ldots \times (1 - \%\text{RedIUGR}^z)
\]

The proportion of IUGR that is reduced by a given intervention is the following:
23) \[ \text{PropRedIUGR}^a = \frac{\%\text{RedIUGR}^a}{(\%\text{RedIUGR}^a + \%\text{RedIUGR}^a + \%\text{RedIUGR}^a + \ldots + \%\text{RedIUGR}^a)} \]

24) \[ \text{PR}_{-\text{IUGR}}^{i,\text{actual}} = \text{WT}_i \times \text{PR}_{-\text{IUGR}}^i \]

25) \[ \%\text{ActualRedMort}^a = \text{PropRedIUGR}^a \times \%\text{ActualRedMort}^{i,j(\text{IUGR})} \]

**Breastfeeding**

LiST calculates the impact of breastfeeding as having a direct impact on mortality. Breastfeeding is characterized by four states: exclusive breastfeeding, predominant breastfeeding, partial breastfeeding and not breastfeeding. The latter three of these states are associated with increased relative risk of cause specific mortality (pneumonia and diarrhea) relative to exclusive breastfeeding. The calculation process is similar to that for calculating the mortality reduction due to an improved HAZ or WHZ distribution.

26) \[ \%\text{RedMort}^{i,\text{breastfeeding}} = 1 - \frac{(\text{AvgRelRisk}^{i,\text{Breastfeeding}t} / \text{AvgRelRisk}^{i,\text{Breastfeeding}0})}{1 + (\text{AvgRelRisk}^{i,\text{Breastfeeding}t} / \text{AvgRelRisk}^{i,\text{Breastfeeding}0})} \]

where \( \%\text{RedMort}^{i,\text{Breastfeeding}} \) is percent reduction in mortality for cause \( i \) resulting from an improvement in breastfeeding.

27) \[ \text{AvgRelRisk}^{i,\text{Breastfeeding}t} = \%\text{Status}^{a} \times 1.00 + \%\text{Status}^{b} \times \text{RelRisk}^{ib} + \%\text{Status}^{c} \times \text{Odds}^{ic} + \%\text{Status}^{d} \times \text{Odds}^{id} \]

\( \text{RelRisk}^{ib/c/d} \) is the risk of mortality in status \( b \) or \( c \) or \( d \) divided by the risk of mortality among children who are exclusively breastfed (\( b = \) predominant breastfeeding, \( c = \) partial breastfeeding, \( d = \) not breastfed)

\( \%\text{RedMort}^{i,\text{breastfeeding}} \) is used in equation 3 for calculating the total reduction in mortality for cause \( i \). Equation 8 calculates the actual percent by which improved breastfeeding reduces mortality. For children greater than 6 months old, when exclusive breastfeeding is no longer the recommended preferentially to predominant or partial breastfeeding, the equations above collapse to two categories: breastfeeding or not breastfeeding.

LiST also has the ability to calculate the percent of children in the various breastfeeding statuses based upon coverage of breastfeeding promotion. The percent reduction in children who are not optimally breastfed\(^a\) is calculated with the following equation.

28) \[ \%\text{OptBreastfed}^t = \{\text{OddsAppBF}^0 \times (\text{AvgOddsRatio}^t / \text{AvgOddsRatio}^0)\}/ \left[ 1 + \{\text{OddsAppBF}^0 \times (\text{AvgOddsRatio}^t / \text{AvgOddsRatio}^0)\} \right] \]

where: \( \%\text{OptBreastfed} \) is the percent of children in a cohort are appropriately breastfed. 
\( \text{OddsAppBF} \) is the odds of appropriate breastfeeding
\( \text{AvgOddsRatio} \) is the weighted average of the odds ratios, similar to equation 12

The distribution of children falling among the other categories of breastfeeding is assumed to remain the same as it was at the baseline. E.g.,
29) \( %\text{PredBreastfed}_t = (1 - %\text{OptBreastfed}_t) \times %\text{PredBreastfed}_0 ) / ( %\text{PredBreastfed}_0 + %\text{PartialBreastfed}_0 \times %\text{NotBreastfed}_0 ) \)

where: \( %\text{PredBreastfed}_0, %\text{PartialBreastfed}_0, %\text{NotBreastfed}_0 \) are the percents of children who are predominantly breastfed, partially breastfed and not breastfed respectively.

**Immunizations and malaria vector control**

In the default operation of LiST the impact of immunizations is handled the same as any other intervention that has a direct impact on mortality. However the user may choose to model the herd effect of immunizations or malaria vector control. The herd effect is modeled as the percent of unimmunized children who are protected by the reduced transmission of the disease resulting from increased immunization rates. If this option is chosen, the user must complete a herd effect schedule which is the percent of unimmunized children who are protected as immunization rates increase. The overall effectiveness of the vaccines is calculated as:

\[
30) \%\text{RedMort}_{ij}(\text{HerdEffect}_t) = \left( \left[ \frac{\{I_{ij} \times (P_{jt} - P_{j0})\}}{(1 - I_{ij} \times P_{j0})} \right] \times \left[ 1 - \frac{(\text{HE}_{ij} - \text{HE}_{ij0})}{(1 - \text{HE}_{ij0})} \right] + \left[ \frac{(\text{HE}_{ij} - \text{HE}_{ij0})}{(1 - \text{HE}_{ij0})} \right] \right) \times \text{AF}_{ij}
\]

where: \( %\text{RedMort}_{ij}(\text{HerdEffect}_t) \) is the reduction in mortality at time \( t \) by cause \( i \) as a result of immunization \( j \) when the herd effect is included.

\( \text{HE}_{ij} \) is the percent of unimmunized children who are protected by the reduction in transmission resulting from an increased immunization rate at time \( t \).

The first piece of the equation, \( \left( \frac{\{I_{ij} \times (P_{jt} - P_{j0})\}}{(1 - I_{ij} \times P_{j0})} \right) \), is the effect of the vaccine on the immunized child. The second part of the equation, \( \left[ \frac{(\text{HE}_{ij} - \text{HE}_{ij0})}{(1 - \text{HE}_{ij0})} \right] \), is the herd effect. These two effects are not completely additive. The term, \( \left[ 1 - \frac{(\text{HE}_{ij} - \text{HE}_{ij0})}{(1 - \text{HE}_{ij0})} \right] \), moderates the direct impact of the immunization on the child in this equation\textsuperscript{vi}.

Table 7 works through an example of this equation. The vaccine effectiveness and the affected fraction are the same regardless of coverage level. The percent of unimmunized children which are protected depends on the coverage level as indicated in Table 8. The percent reduction in mortality as a result of the increased immunization coverage is calculated with equation 30:

\[
%\text{RedMort} = \left( \left[ \frac{\{0.850 \times (0.750 - 0.250)\}}{(1 - 0.850)} \right] \times \left[ 1 - \frac{(0.500 - 0.200)}{(1 - 0.200)} \right] + \left[ \frac{(0.500 - 0.200)}{(1 - 0.200)} \right] \right) \times 1.000 = 0.712
\]
Table 7: Reduction mortality from immunization when the herd effect is included

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Target year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immunization effectiveness</td>
<td>0.850</td>
<td></td>
</tr>
<tr>
<td>Affected fraction</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>Immunization coverage</td>
<td>0.250</td>
<td>0.750</td>
</tr>
<tr>
<td>Percent of unimmunized children who are protected @ coverage level (from Table 7)</td>
<td>0.200</td>
<td>0.500</td>
</tr>
<tr>
<td>Percent reduction in mortality due to vaccine scale up</td>
<td></td>
<td>0.712</td>
</tr>
</tbody>
</table>

Table 8: Notional table of immunization coverage versus percent of unimmunized children who are protected

<table>
<thead>
<tr>
<th>Immunization coverage</th>
<th>0 - 49.9</th>
<th>50 – 59.99</th>
<th>60 - 69.9</th>
<th>70 - 79.9</th>
<th>80 - 89.9</th>
<th>90 - 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of unimmunized children who are protected</td>
<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
<td>0.7</td>
<td>1</td>
</tr>
</tbody>
</table>

The same approach can be used with the impact of indoor residual spraying and use of insecticide treated nets so that high levels of coverage of these interventions can disrupt transmission, yielding protective effects even for households that were not directly protected by the interventions.

**Therapeutic Feeding**

Therapeutic feeding is the only intervention that affects the percent of children who are severely wasted (<=-3 SD WHZ). LiST calculates the percent reduction in the proportion of children who are severely wasted with following equation:

\[ %\text{RedWasting}^{TF} = I^{TF} \times \left( P^{TF_t} - P^{TF_0} \right) / \left( 1 - I^{TF} \times P^{TF_0} \right) \]

Similar to the calculations for reduced stunting, the reduction in the percent of children who are severely wasted causes a shift in the curve describing the distribution of children across weight for height statuses. This shift in turn causes the risk of mortality to decline.

**Incidence of diarrhea**

One of the factors affecting height for age (stunting) in LiST is the incidence of diarrhea\textsuperscript{iii}. The incidence of diarrhea is in turn affected by several water and sanitation interventions including improved water source, safe water within 30 minutes, improved excreta disposal, hand washing and hygienic disposal of children’s stools\textsuperscript{iv}.

The percent by which an intervention will decrease the incidence of diarrhea from a baseline level is described by the following equation.
%RedDiarr\_j^t = \frac{I^{\text{Diarr},j} \cdot (P^j_t - P^0_t)/(1 - I^{\text{Diarr},j} \cdot P^0_t) \cdot AF^{\text{Diarr},j}}{\text{where } \%\text{RedDiarr}^t_j = \text{the percent by which diarrhea incidence is decreased by intervention } j \text{ at time } t} \}

The total reduction in diarrhea incidence is calculated with the following equation:

\%\text{RedDiarr}^{\text{total}}_t = 1 - [(1 - %\text{RedDiarr}^a_t) \cdot (1 - %\text{RedDiarr}^b_t) \ldots \cdot (1 - %\text{RedDiarr}^c_t)]

The incidence of diarrhea is calculated as:

\text{IncDiarr}_t = \text{IncDiarr}_t \cdot \%\text{RedDiarr}^{\text{total}}_t

The odds ratio for stunting as a function of diarrhea incidence is:

\text{OR}_{\text{Stunting,DiarrInc}} = \text{DiarrEff}^{\text{IncDiarr}_t}

The percent reduction in stunting is then calculated with equations 13 and 14 above. This percent is then used as part of the calculation in equation 15 for the total percent reduction in stunting.

**Nutritional deficiencies and exposure**

Levels of vitamin A deficiency, Zinc deficiency and exposure to Falciparum malaria are not identical in all countries. Therefore in the health statuses page of LiST the user may choose to turn on or off the parts of the model that allow Vitamin A, Zinc or antenatal malaria protection based on the specific levels of deficiencies or exposure to falciparum in the country or area to be modelled. If the user chooses to activate the Vitamin A or Zinc parts of the model, LiST assumes that all children in the country are deficient. Therefore the affected fraction would be 1.00. On the other hand, when the antenatal malaria protection is activated the user may specify the percent of the population exposed to Falciparum malaria which will then be used as the affected fraction.

**Calculation of deaths averted**

The LiST module of SPECTRUM calculates the percent decline in mortality as a result of a program of intervention scale up. The new mortality rate for a given cohort is calculated with the following equation:

\text{m}_t = m_0 \cdot (1 - \%\text{RedMort}^{\text{total}}_t)

By interpolation and curve fitting\textsuperscript{v}, LiST calculates single year cohort mortality rates based on the LiST cohort mortality rates\textsuperscript{vii}. These adjusted mortality rates are sent to DemProj, a demographic projection module within SPECTRUM. SPECTRUM then calculates the number of deaths that occurs in each age band.

LiST calculates the number of deaths averted for a given cohort with the following equation:

\text{DeathsAverted}^{\text{Total}}_t = \text{DeathsTotal}_t/(1 - \%\text{RedMort}^{\text{Total}}_t) - \text{DeathsTotal}_t

The number of deaths averted by particular cause i for a given cohort is calculated by:

\text{DeathsAverted}^{i}_t = \text{DeathsAverted}^{\text{Total}}_t \cdot (%\text{RedMort}^{i}_t / %\text{RedMort}^{\text{Total}})
The number of deaths averted by particular intervention \( j \) for a given cohort is calculated by:

\[
\text{DeathsAverted}_t = \text{DeathsAverted}_{Total} \times \left( \%\text{RedMort}^{Total}_t / \%\text{RedMort}^{Total}_t \right)
\]

where:

\[
\%\text{RedMort}^{Total}_t = \%\text{Deaths}_0 \times \%\text{RedMort}^{1,j}_t + \%\text{Deaths}_0 \times \%\text{RedMort}^{2,j}_t + \ldots + \%\text{Deaths}_0 \times \%\text{RedMort}^{n,j}_t
\]

where \( \%\text{Deaths}_0 \) is the percent of deaths at baseline due to various causes of death. \( \%\text{RedMort}^{n,j}_t \) is the percent of cause specific mortality averted by intervention \( j \) at time \( t \).

\( \%\text{RedMort}^{Total,j}_t \) is the percent of all deaths in a cohort averted by intervention \( j \) at time \( t \).

**Future directions**

The LiST model is currently being expanded to include the impact of interventions on maternal mortality and still birth rates. Like with the previous work, these models are based on assumptions about cause-specific maternal mortality and the effectiveness of interventions that have been produced or reviewed by the Child Health Epidemiology Reference Group and the sponsoring groups, WHO and UNICEF. As with all of this work, we are striving to ensure that the assumptions and modelling structure used within LiST have been carefully reviewed within the CHERG framework and are available for comments and suggestions from the broader public health community.

**Acknowledgments**

This work was supported in part by a grant to the US Fund for UNICEF from the Bill & Melinda Gates Foundation (grant 43386) to “Promote evidence-based decision making in designing maternal, neonatal and child health interventions in low- and middle-income countries”.

---

\(^{i}\) See Stover et al. in this issue of IJE.

\(^{ii}\) An exception to this general rule is the impact of immunizations where LiST allows the impact of herd effects to be modelled.

\(^{iii}\) A fixed absolute amount implies that the total impact of the interventions would be arrived at by summing the independent impact of the interventions. The problem with such an approach is that the total impact of the interventions could exceed the baseline mortality leading to a negative mortality rate.

\(^{iv}\) To somewhat reduce the proliferation of subscripts this discussion does not subscript the equations for cohort. However, the reader should understand that most all of the equations that follow are for a single cohort.

\(^{v}\) The modelling of weight for height, which is much simpler, is described below.

\(^{vi}\) Note however, that the WHZ of children surviving to the end of a cohort is not an input to the WHZ calculations for the next age band since nutritional deficiencies proxied by weight for height are assumed to be acute rather than chronic.
li Nutritional status as measured by height for age and weight for height are not considered risk factors for neonatal mortality in the model. On the other hand, Intra-uterine growth retardation described below is a risk factor for both neonatal mortality and for stunting at the end of the neonatal period.

lii Changes in IUGR impact the stunting at the end of the neonatal cohort while changes in stunting from previous cohorts impact stunting at the end of the 1-5, 6-11, 12-23 and 24-59 month cohorts.

lix Each of these interventions have particular details in their implementation that are described below.

lx The impact of nutrition interventions will carry over from cohort to cohort. This leads to the phenomena that LiST will continue to show the echo of the impact of a neonatal nutrition intervention or an intervention reducing IUGR in the 24-59 month cohort.

lix LiST defines optimal breastfeeding as exclusive breastfeeding for children less than six months and any form of breastfeeding for children over six months.

lix The equation could just as well have the term \( \frac{I_{ij} * (P_{jt} - P_{j0})}{(1 - I_{ij} * P_{j0})} \) to moderate the herd effect. The equation would be:

\[
\text{%RedMort}_{ij}(t) = \left( \frac{I_{ij} * (P_{jt} - P_{j0})}{(1 - I_{ij} * P_{j0})} \right) + \left( \frac{I_{ij} * (P_{jt} - P_{j0})}{(1 - I_{ij} * P_{j0})} \right) \times \text{AF}_{ij}
\]

Algebraically the equations are the same.

lix The incidence of diarrhea calculated here impacts only stunting. The direct impact of interventions on diarrhea mortality implicitly includes both an incidence reducing element and a curative element.

lixv Although breastfeeding could be expected to reduce the incidence of diarrhea it is not included here because the best estimates of the mortality reducing impact of breastfeeding do not disaggregate the incidence reducing aspect of breastfeeding from the direct nutritional impact of breastfeeding.

lix The curve that is a log-linear equation fit to the neonatal, infant and the under five mortality rates derived from the cohort mortality rates.

lixvi Recall that the LiST uses cohorts of neonatal, 1-5 months, 6-11 months, 12-23 months and 24-59 months.